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Final report to the Board of Natural Resources & Conservation on the Bonneville Power Administration's

Final Report
to the
Board of Natural Resources & Conservation
on the
Bonneville Power Administration's
500 Kilovolt Transmission Line
from Townsend — Garrison, Montana

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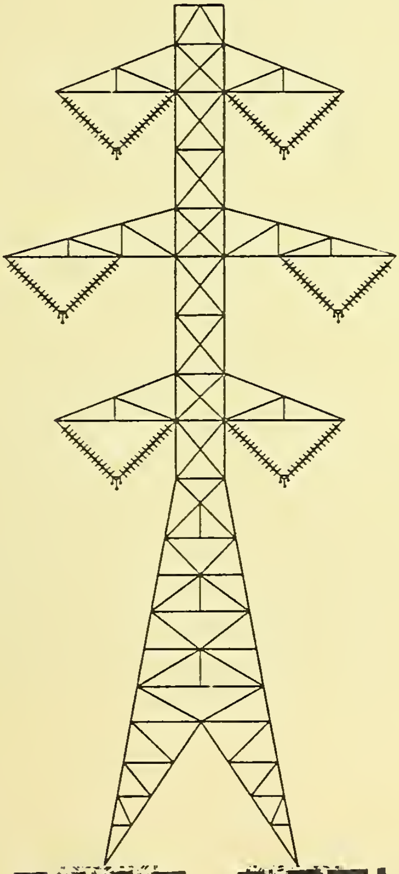

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FINAL REPORT
TO THE
BOARD OF NATURAL RESOURCES & CONSERVATION
ON THE
BONNEVILLE POWER ADMINISTRATION'S
500 KILOVOLT TRANSMISSION LINE
FROM TOWNSEND - GARRISON, MONTANA

AN ADDENDUM TO THE FEDERAL COLSTRIP PROJECT EIS

Department of Natural Resources and Conservation
June 1982

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SECTION I

INTRODUCTION

The Board of Natural Resources and Conservation (Board) must determine whether Bonneville Power Administration's (BPA) plans to construct a double-circuit 500 kilovolt (kV) transmission line from Townsend to a new substation at Garrison, Montana are in compliance with the substantive standards of the Major Facility Siting Act (MFSA). To assist the Board in its decision, the Department of Natural Resources and Conservation (DNRC) published a draft report in April 1982, entitled "Draft Report to the Board of Natural Resources and Conservation on the Bonneville Power Administration's 500 Kilovolt Transmission Line from Townsend-Garrison, Montana." The draft report was an addendum to the federal Colstrip Project environmental impact statement (EIS). It evaluated the information contained in the EIS and other federal documents and is hereby incorporated in this final report by reference.

On April 30 and May 1, 1982 the Board conducted a hearing to gather public comments on the draft report and to hear testimony from the public concerning BPA's plans. This hearing was held in conjunction with the Department of Health and Environmental Sciences (DHES) which is required to determine whether the line will comply with legal requirements concerning air and water quality and solid and hazardous waste disposal.

This final report, which is a final addendum to the Colstrip Project EIS, presents additional discussion and findings in a number of topic areas raised during the Board's hearing or raised by new information which has become available (Section

II). Summarized comments and questions raised by the public are also addressed (Section III). A comparison of alternative routes for the proposed facility, mitigation measures and DNRC's recommendations to the Board are presented in Section IV.

Project Summary Description

BPA's proposed transmission line and substation will deliver electrical energy from Colstrip Unit 3 to the existing 230 kV transmission system, which includes lines owned by BPA and Montana Power Company. BPA's preferred route between Townsend and Garrison, labelled "BPA Final Route," is shown in Figure 1, along with two alternative routes. The transmission facility would be a double-circuit 500 kV line located in a 125 foot right-of-way on self-supporting, stacked steel towers averaging 162 feet in height. An average of 4.5 towers would be built per mile, depending upon terrain. The proposed project includes a new substation near Garrison, Montana which would cover approximately 50 acres. The peak of the construction work force would number 150-225 persons during the 1982 and 1983 construction seasons in three separate construction spreads. A detailed engineering description of the project and construction activities is contained in the Colstrip Project EIS Final Supplement, Appendix A (USDI 1981a).

Summary Findings of the Draft Report

While recognizing that there is no single "best" method of analyzing and comparing the many complex variables involved in siting a transmission line, DNRC identified a number of shortcomings in BPA's siting process for this line.

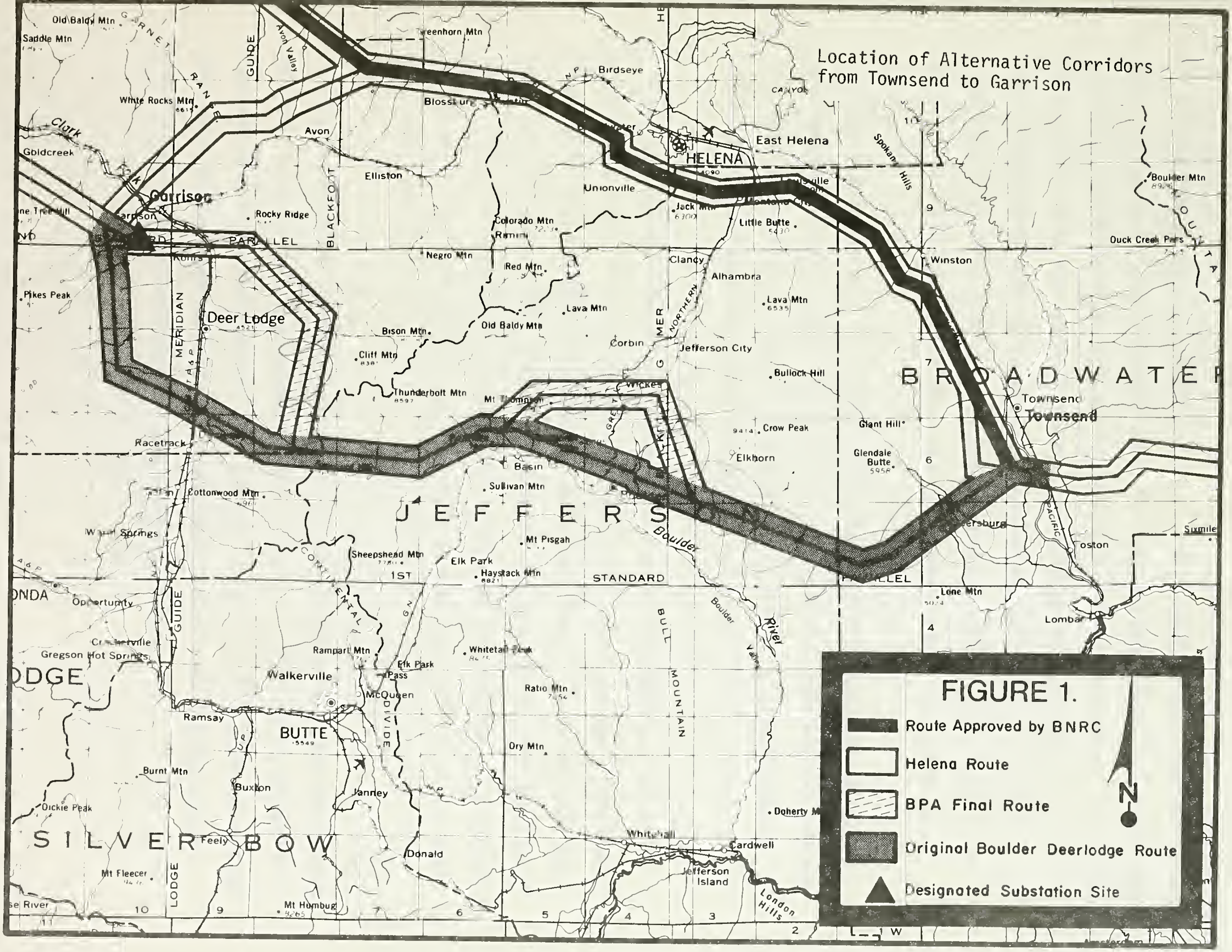


FIGURE 1.

Location of Alternative Corridors from Townsend to Garrison

No systematic attempt was made to gather public input at the stages of the study when corridors were initially identified and compared (see Section II of this final report). When public concern surfaced after selection of the Original Boulder-Deer Lodge (BDL) Route, the study was re-opened to consider new alternatives, but the route changes that were then made in response to the public concerns are not comparable with the earlier study results. Also the federal studies relied on earlier studies of the project which did not assume a substation at Garrison.

The methods used did not clearly define the subjective decisions and site specific evaluations of impact that were made to arrive at the numerical rankings assigned to the various alternative routes. As a result, the significance of numerical differences between impact scores is not clear.

Due to the high level of public concern and controversy that has already occurred concerning this project, it is highly questionable whether it would be possible to obtain a measure of baseline social attitudes for any community that would be potentially affected by any alternative route in the Townsend-Garrison area. The social impact of re-opening the question of line location is likely to be large, and there is no guarantee that more people would be satisfied if the route location is changed.

Health and safety hazards caused by electrical effects of the line are an issue of major public concern (see Section II of this final report). BPA's 125 ft right-of-way is relatively narrow. The width is important for purposes of keeping dwellings and some human activities a sufficient distance away from the lines. Noise outside the right-of-way is also a significant issue.

Considerable public controversy generated in the Boulder and Deer Lodge areas caused potential impacts on agriculture to be given a very high weight in the selection of the BPA Final Route. This weighting seems to be more a measure of public opposition to siting the line on private land than a weighting of the actual future impacts to agricultural land that would occur, particularly if careful attention were given to avoiding these impacts through centerline selection and tower placement.

An intensive inventory to identify specific historic and archaeological sites was done by BPA for the centerline of the BPA Final Route rather than during the corridor analysis; this is normal practice. However, the corridor analysis should identify known cultural resources along each route, especially those which would influence corridor selection. BPA has stated that it will comply with the Historic Preservation Act, which requires full identification of sites, evaluation of their significance, determination of impacts, and appropriate mitigation. This compliance would satisfy MFSA. For the BPA Final Route, the State Historic Preservation Officer (SHPO) reports that compliance procedures are being followed but are not yet complete (see Appendix E of this final report).

General impacts of transmission lines on recreation were given adequate consideration by BPA. However, problems with interpreting BPA's study methodology make it impossible to determine significant differences in recreation impact among the alternative routes.

Visual concerns were given generally adequate attention, and consistently high weightings in corridor comparison by BPA. However, the study results were given contradictory treatment in route selection. The numerical differences among the alternatives were not significant enough to determine which would be preferred from a visual perspective. Visual impacts to historic sites outside the right-of-way but within the line of sight were not addressed.

Water resources information and geological information were adequately presented and discussed by BPA. Since transmission lines can be built over nearly any terrain, most geologic considerations are important only during the centerline evaluation. From the data provided it appears that none of the alternate corridors are particularly advantageous considering only geologic factors.

DNRC agrees with BPA's conclusions concerning wildlife and vegetation that: 1) the BPA Final Route would potentially have the greatest effect on the wildlife and plant resources, and 2) the Helena Route would minimize (to the degree possible) impacts to the wildlife and vegetation.

For the most part engineering factors are of minor concern because major system design components and the need for the project have been established. A comparison of the construction costs of the alternative routes is presented in Section II of this final report.

Based on numerical impact scores from the federal studies, the BPA Final Route ranks best for only one of the 12 siting determinants considered in the federal studies. That determinant, agricultural land, was given a high weight in the corridor ranking process to reflect strong public reaction that agricultural lands should be avoided. The BPA Final Route is also worst in terms of the total impact scores when compared to the Original BDL Route and the Helena Route. The federal Record of Decision (ROD) (USDI 1981b) clearly states that BPA's Final Route is not environmentally preferred for the majority of the study determinants. DNRC generally agrees with these results but due to problems in interpreting the study methodology, could not determine which route is most acceptable for all the individual environmental, social and cultural factors. Table 7 in Section II of this report presents ranking scores for the 12 siting determinants included in BPA's studies.

Construction on the Townsend-Garrison line was originally scheduled to begin in March 1982 and to be completed in October 1983. BPA has indicated the construction schedule is extremely tight. DNRC was unable to identify any measures which would be effective in significantly reducing the construction schedule other than possibly adding more and smaller "spreads" to the construction plan. If construction is not completed by early winter in 1983, weather conditions may delay completion until the summer of 1984.

Montana Power Company (MPC) estimated the cost for each month of delay in the completion date of the transmission line to Garrison in two ways: 1) the cost of buying replacement power for the full output of Unit 3, plus additional interest costs; and 2) the cost of buying replacement power only to relieve the net deficits among the participants created by a delay in commercial operation of Unit 3.

MPC estimated the cost of replacement power from oil or gas fired combustion turbines for Colstrip Unit 3 (assuming 525 average MW) at $30 million per month, while replacement power only for the deficits of the five utility owners would be $24 million per month. MPC also contended that a delay in commercial operation of the plant would lead to additional AFUDC (allowance for funds during construction) of $10 million per month.

DNRC disagreed with these values on several grounds. 1) MPC's deficit figures are based on critical water conditions which have a low probability of occurrence. 2) The replacement cost per kilowatt-hour depends on the source of the replacement energy which would not necessarily be produced from combustion turbines, a worst case option. 3) Under different water conditions portions of the output of Unit 3 would be replaced by (a) oil or gas combustion turbines, (b) combined cycle plants or higher cost steam plants, or (c) be sold to other utilities or other regions to displace energy from sources like (a) or (b). The expected cost of delay could be calculated by taking a weighted average of the costs with different possible water conditions. 4) It is double counting to add the plant interest costs to the replacement power costs to determine a "total" cost of delay.

Under critical water conditions, if one ignores surplus sales, and if combined cycle units are used by utilities which own them, the monthly cost of replacement energy would be $12.8 million. If the Colstrip energy of all deficient utilities were replaced by running combined cycle units, the monthly cost would be $9.6 million.

DNRC's analysis ignored the value of surplus sales and therefore understated the loss in critical water (see Section II of this report, Economic Considerations). The impact on ratepayers of a delay in Unit 3 is uncertain if surpluses of some of the Colstrip project owners are marketed to other utilities. A negotiated price would split any savings between the purchasing utility and the selling utility. The actual distribution of costs between MPC's ratepayers and its shareholders cannot be determined, as it depends on how the Montana Public Service Commission decides to treat surplus sales from Unit 3 in determining the revenue requirements of the company. In any event, in its draft report DNRC estimated the costs of delay at between $9.6 and $12.8 million per month.

Section II ADDITIONS AND CORRECTIONS TO THE DRAFT REPORT

This section presents information which has become available since publication of DNRC's draft report, including evaluation and discussion of issues raised during the Board's public hearing, and discussion of site specific concerns identified either in the draft report or during the public hearing which required more detailed analysis to aid the Board in its decision. Corrections to the draft report are also presented. A number of topics discussed in this section are referenced in exhibits introduced during the Board's hearing. A list of the exhibits is contained in Appendix A. A complete set of the exhibits is available for public inspection at DNRC headquarters, 32 So. Ewing, Helena.

A number of questions pertaining to the engineering of the line have been raised, including the function of the proposed substation and how the 500 kV line will tie into the existing 230 kV system. Appendix B contains a discussion of electrical engineering terms to assist the Board and other readers in their review of portions of the material presented in this report.

Public Involvement

During the Board's hearing, BPA presented testimony and made additional information available to the Board concerning its public involvement process on the Colstrip project. Public involvement by BPA consisted of four parts (Darby testimony; Exhibits 31 G,H,K,M,; Darby 1982a). The first was an analysis performed in 1977 of the public meetings and comments received by DNRC on its 1974 draft EIS and transcripts of the Board's hearings, with emphasis on comments on the transmission lines. As BPA states in its letter of May 3, 1982, from Omar Halvorson to Steve Brown (Exhibit 31), "There was very little input from the transcript regarding transmission line location; virtually all the testimony had to do with need for the project, the coal mining and generating plants." BPA's second effort at public involvement in September 1977 was mailing out a brochure, with a stamped, self-addressed comment card, to about 1500 persons on their mailing list throughout the study area. This mailing was made during preparation of the TER; about one hundred replies were received for a response rate of 7 percent. Following issuance of the federal draft EIS, the federal agencies held five public meetings (Butte, Helena, Billings, Forsyth, and Missoula). Prior to the public hearings, Ron Wilkerson, BPA's Colstrip Project Manager, toured the state, meeting with news media, government officials, and environmental and industry groups, to publicize the hearings. Following the public comment period, a content analysis was made of comments pertaining to the transmission lines, but, again, these comments were relatively few, with the generation plants receiving the most attention. As the content analysis states, "The public did not know that a separate content analysis would be conducted on the transmission corridor portion of the draft EIS, and therefore, they did not aim their comments directly at that subject" (Exhibit 31M).

The Record of Decision (ROD) was issued in September 1979 (USDI 1979b). The ROD stated that the Townsend-Boulder route was the preferred route and that BPA would build the line from Townsend west. The ROD was sent to about 1400 persons on BPA's Colstrip EIS mailing list, which included state and local governments; an additional 300 copies were distributed to media contacts throughout Montana and to the Congressional delegation; and an AP news story went out to papers statewide (Darby 1982a). No comments or protests were received (Darby 1982b).

Neither BPA nor BLM could locate the mailing list that was used to send out the TER brochure and the ROD (Haas 1982b). The Colstrip EIS mailing list was found, but it only contained about 550 names, more than a third of which were federal and state government agencies and officials. Another quarter of the names were out-of-state businesses or individuals. Another quarter were county planning boards, local libraries, state colleges and universities, and news media. The remainder were Montana businesses, interest groups, and individuals. This mailing list was a fairly conventional one for EIS mailings, with an emphasis on government agencies. News media coverage was relied on to gain the attention of the public. The larger mailing list may have contained more individual Montanans throughout the study area, but without the list, the individuals notified in the Townsend to Garrison area cannot be determined. The Colstrip EIS mailing list contained only one individual from Boulder, one public interest group from Townsend, one library in Deer Lodge, one U.S. Forest supervisor each in Deer Lodge and Townsend, and the county planning boards in Townsend, Boulder, and Deer Lodge. This suggests that many of the people who were finally affected by the line were probably not notified.

Several things must be kept in mind in evaluating public comment obtained during the federal process. Throughout the federal EIS process from 1974-1979, the project under review was the same as that reviewed by the state: the plants at Colstrip and alternative routes for the transmission lines to Hot Springs with Montana Power Company responsible for construction. While the option for BPA to build a portion of the lines was mentioned in the EIS's, the EIS's contained no recommendations on the subject, and no recommendations as to the preferred route (Montgomery 1981, p. 13). Since 1976, the Board-certified route was considered the applicant's proposal, and the principal rationale for the federal EIS was to grant rights of way across federal lands. The Colstrip plants were tied up in legal proceedings and up to 1979 it was not certain whether they would be built. As noted above, the bulk of testimony and comment on the EIS's concerned the issue of whether the entire project should or should not be constructed. All of these factors suggest public attention was never focused on the issue of transmission line routing and construction.

DNRC's assessment of BPA's public involvement program up through the 1979 ROD is that it was inadequate. The 7 percent response rate that BPA obtained on its principal effort to obtain public comment was too low to be reliable. BPA did not attempt to contact the 93 percent who did not respond, or to boost the response rate with subsequent mailings.

Survey research methodology has progressed to the point where 7 percent is not an acceptable rate of return. It is not statistically reliable. Response rates of 30 to 40 percent are regularly obtained by mail surveys and these return rates can be raised to 70 percent with follow-up mailings (Dillman 1978). In a recent DNRC survey of northwestern Montana residents, for example, 81 percent of the persons receiving a 16-page questionnaire completed and returned it (Allen 1981).

BPA's initial public involvement effort appears to have been inadequate for at least two reasons. BPA did not use up-to-date survey methods, and did not obtain a meaningful measure of public attitudes and opinions. Further, the nature of the project being evaluated in the federal documents kept changing (see Montgomery, 1981). Thus, it is not unreasonable for members of the public to contend, as they did at the Board's recent hearings that they knew nothing of the project until BPA began centerline negotiations.

The problems with BPA's public involvement efforts could only be rectified if the entire process of alternative route evaluation were re-initiated. Otherwise the after-the-fact public involvement that led to BPA's supplemental EIS and selection of the BPA Final Route to accommodate local concerns will have to suffice.

If the Board were to decide that BPA should construct the line on the Helena route, the people affected would be in much the same position as those on the Original Boulder-Deer Lodge route when BPA began its centerline studies. Some centerline evaluation on the Helena route was done in 1977-78 by MPC and DNRC, from Townsend to Helena (DNRC 1978). No centerline work has been done from Helena to Garrison.

The proposed 500 kV transmission line project differs in several important respects from the MPC line certified by the Board in 1976. The design and resulting visual impacts are different, no taxes will be paid to local governments, and BPA rather than MPC will construct, own, and operate the line. Land-use changes have occurred since 1976 (see section on land-use). Further, portions of the route differ from that certified by the Board. As a result of these differences, some members of the affected public would likely feel much the same way that some residents along the Boulder-Deer Lodge route felt - that they knew nothing about the proposed project prior to centerline studies. Public opposition groups that were once active when the line was proposed through Helena to Helmville and beyond could reformulate.

HOUSING AND SOCIAL SERVICE IMPACTS

DNRC's draft report noted (p. 22) that the demand for transient lodging (motels and recreational vehicle hookups) created by tourists and the incoming construction workers may exceed the number of units available in Deer Lodge. Motels there are generally filled to about 95 percent capacity during the summer months,(USDOE 1982a; Appendix D; Masters 1982).

The Deer Lodge Chamber of Commerce states that up to 60 construction workers could be readily accommodated at the old hotel and rooming house in Deer Lodge, thus avoiding any conflicts with summer tourists for motel space. The Chamber has stated that it is prepared to offer BPA or its construction contractors whatever assistance is needed to locate accommodations for construction workers (Waldron 1982).

Since DNRC's draft report was prepared, construction at the limestone mine near Townsend and oil and gas exploration activities have caused the motels to be filled. According to the Chamber of Commerce Secretary, there are still some rentals being advertised in the paper, and some empty trailer spaces (Upton 1982). Coordination with local realtors might result in additional places being found, or powerline construction workers could commute from Helena (Upton 1982; Tichenor 1982).

Helena and Boulder appear to have sufficient excess capacity to house construction workers without requiring advance planning.

Public Service Impacts

Concern about impacts on local government and private service providers was raised by a number of commentors at the Board's hearing. For the Garrison-Spokane portion of the Colstrip 500 kV line, BPA hired Mountain West Research, Inc. (MWRI) of Billings to conduct a study (1981) of rural communities that have been affected by BPA 500 kV line construction. This study included about a dozen small communities in Oregon, Idaho, and Washington, and constitutes the only data available on the effects of transmission line construction on local community services and businesses.

MWRI interviewers asked community residents what effect line construction was having (or, for previously impacted communities, what effects they remembered). MWRI asked local officials whether there had been any problems with housing, or adequacy of public facilities or services as a result of construction workers coming in. Community officials of previously impacted communities were also asked what long-term effects there had been. One community mentioned there had been insufficient housing, and that had been a problem. No other community service problems were mentioned by any of the communities as being significant. MWRI did not ask what specific costs had been incurred by local governments to provide services to the BPA facility or the construction workers.

Transmission line construction is short-term and does not involve large numbers of construction workers (see DNRC draft report, p. 22). Therefore it usually does not require that new housing or public facilities be built. MWRI's study showed that construction workers, being seasoned transients were able to quickly determine whether a community could accommodate them in terms of housing and services (MWRI

1981, p. 81). If a reporting station was located in a community too small to accommodate them, the research showed that they went to the nearest town offering accommodations. Thus, existing data show that impacts from construction workers are unlikely to be significant.

None of the communities surveyed by MWRI reported any organized opposition to the line. One community was described as "accepting such projects with resignation" (MWRI 1981, p. 73). Other communities interviewed were suffering from the economic slump in the timber industry and were glad for the economic boost of construction worker spending.

In some Montana communities, organized opposition and dissatisfaction with BPA's public involvement and easement negotiations have required expenditures of time on the part of some local government officials in planning for the line (Woodgate 1982). While the costs may not be great, they are probably higher than they would be in a community that welcomed the line, anticipating only economic benefits from construction worker spending.

In its recently proposed rules for providing impact aid, BPA states that it does not know what costs have been incurred by local governments in providing services to BPA lines (USDOE 1982b, pp. 4-5). Therefore, BPA proposes to have local governments keep records of actual costs of services provided on behalf of BPA facilities, and submit these actual costs to BPA for reimbursement. Local governments must document actual expenditures of at least $1000 before reimbursement can occur. Once they meet this threshold requirement, all documented costs could be reimbursed. BPA retains discretion as to whether any impact aid payments are made. The language in the proposed rules reads, "The BPA Administrator _may_ make impact aid payments."

(USDOE 1982b, emphasis added; this point was stressed by BPA officials at the public hearings on the proposed rules.) The earliest allowable reimbursement date under BPA's proposed formula is late 1984.

BPA is currently receiving public comment on its impact aid proposal. Those who commented at public hearings in Montana communities indicated extreme dissatisfaction with BPA's proposal. Comments have been made by state and local government officials. The principal concern expressed in Montana is that BPA has too narrowly interpreted its authority to make impact aid payments. Montanans would like to see BPA make payments in lieu of taxes, to compensate local communities for the foregone revenues had the line been built by a private utility. Congress has not authorized BPA to make in lieu of tax payments; therefore, Montanans' desires in this regard cannot be met.

However, there is a considerable gap between the very narrow definition of impact aid proposed by BPA (payment for actual costs of documented services to the facility) and something short of in lieu of tax payments. The former is calculated in a few hundred or few thousand dollars for a county for the two year construction period; foregone revenues from taxes had the line been built by a private utility could have a value of one hundred thousand dollars annually.

BPA will receive public comments on its impact aid proposal until July 13. It will not be known until after that date whether BPA will revise its proposal to accommodate Montanans' concerns.

Given the high level of local concern in Montana about impacts from the Colstrip line, including services that local governments may have to provide on behalf of the facility, and given the apparent dissatisfaction with BPA's proposed impact aid formula, BPA should follow the mitigation measures identified in the TER, DEIS, and FEIS Supplement (USDI 1978, p. VIII-15 to 17; USDI 1981a, p. 2.2; USDI 1979a, pp. A3.3.3-9). These measures, combined with the suggestions made by commentors at the Board's hearing, include meeting with local officials and service providers in each affected community prior to construction to advise them of the temporary increase in population, when the increase is expected, and where the workers will be stationed. Maps of the line and access roads should be available at these meetings so that service providers can determine where and when any problems could arise. If problems relating to inadequate housing, schools or other facilities are identified, the contractors can provide this information to immigrant workers and advise them to locate where there are adequate facilities. Arrangements can be made for emergency or other services that might be needed during construction. Access road areas that may present trespass problems from recreationists can be identified, and plans made for restricting access, if necessary.

Specific public comments concerning law enforcement and impacts on county roads are addressed in Section III of this report.

TAXATION

A major public concern associated with BPA's construction of the Colstrip transmission line is the taxes that would have been paid if a private utility rather than a public agency were building the line. As a federal government agency, BPA legally cannot pay taxes to state and local governments unless directly authorized to do so by Congress. Therefore, while this is a major issue of public concern, it is not within the Board's authority to resolve. However, the Board has expressed an interest in clarifying the amount of taxes that would have been paid on this facility had it been built by a private entity. DNRC has calculated the taxes for the alternative routes based on construction costs presented later in this section and in Table 1. The taxable valuation of each route, which is also contained in Table 1, is calculated by multiplying the construction costs by 12 percent, the taxable percentage of centrally assessed utility property. The taxable valuation is the value against which mill levies are applied to compute the taxes paid on a parcel of property.

TABLE 1

Tax Calculations for Alternative Routes

	Construction Costs	Taxable Value
Helena Route		
Transmission line	$54,100,000	$ 6,492,000
Garrison substation	35,000,000*	4,200,000
BPA Final Route		
Transmission line	$68,300,000	$ 8,196,000
Garrison substation	35,000,000*	4,200,000
Original Boulder-Deer Lodge Route		
Transmission line	$58,400,000	$ 7,008,000
Garrison substation	35,000,000*	4,200,000

* This does not include $10,700,000 in construction costs for additions that would be made to the substation during the proposed Garrison-Spokane portion of the project.

If the lines could be taxed, the percentage increase in taxable value would range from less than 1 percent in some school districts to over 400 percent in others. Many school districts would experience increases in the 30 to 60 percent range. The impacts of these increases on taxpayers would depend on the extent local school boards vote to increase revenues or reduce mill levies.

HEALTH AND ENVIRONMENTAL EFFECTS OF ELECTRICAL FIELDS

The comments received by the Board about human health, safety, and the environmental implications of this high-voltage transmission line indicate a high level of public concern. This concern is understandable: to some people the line represents an abrupt, imposing and unwelcome intrusion of high technology that will remain on or close to their property. The comments also clearly indicate that the BPA has not succeeded in reassuring the public about the health effects issue. As discussed elsewhere in this report, and in DNRC's draft report, this lack of reassurance may be caused partly by BPA's failure to involve the public early in the route selection process, and partly by BPA's interpretation of data and application of this data to such issues as right-of-way width and mitigation measures which would reduce electrical effects of the line.

Elsewhere in the United States there are large numbers of people that live close to large transmission lines with no known ill effect. Thus the issue is one of potential long-term, low effects rather than any immediate and clearly defined danger.

While electrical effects of transmission lines have not previously been a public issue of any consequence in Montana, these effects have received a high degree of attention elsewhere by the public, scientists, and regulatory agencies. The research findings and the knowledge gained by other state regulatory agencies, although not entirely applicable to Montana, is the primary foundation for the findings in this report. The experience of two states in particular, New York and Minnesota, is especially pertinent. For example, electrical effects were the subject of in-depth testimony during hearings of the New York Public Service Commission. The executive summary of a U.S. Department of Energy report analyzing the expert testimony presented at the hearings is attached as Appendix C (Scott-Walton, et al 1979). While this material is not as recent as the research discussed in the following sub-section, it is still accurate and is included to provide the Board an overview of the issues.

Research on Low-level Biological Effects

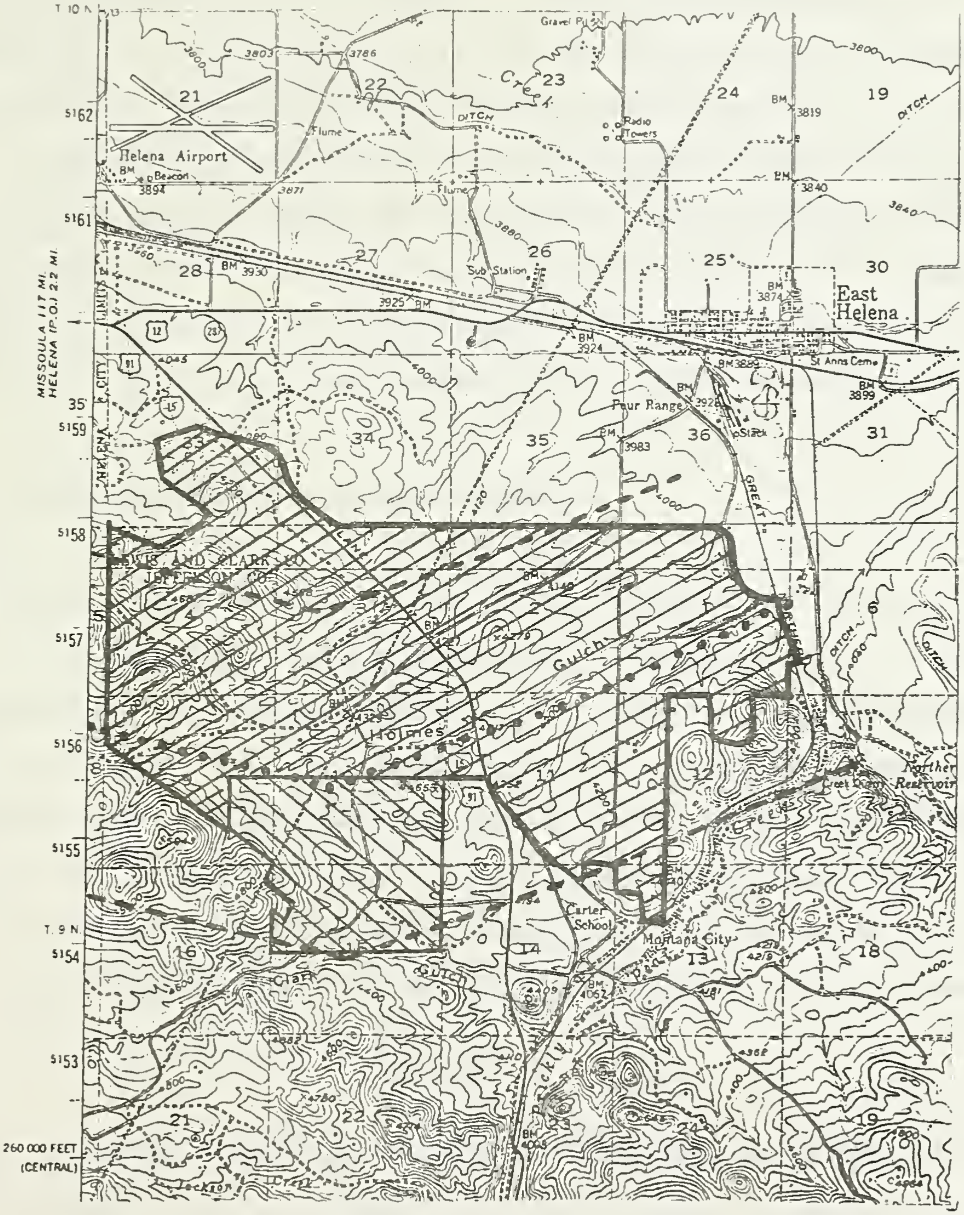
Two important background issues to consider in evaluating biological effects of transmission lines are: 1) problems with accurate scientific identification of these effects or impacts of electrical fields, and 2) problems with determination of hazard. The latter is a legal and regulatory decision made in adversarial circumstances (Scott-Walton et al. 1979).

Scientific research on low-level biological effects is difficult. In spite of the need for public reassurance, scientists can never say with absolute certainty that there are no effects. Research findings are based on probabilities. Also, the complexity of biological systems causes large margins of uncertainty. These uncertainties in turn cause many regulatory problems when there are questions of potential human injury and high economic cost.

Determination of risk occurs after biological effects have been described. If biological or health effects are demonstrated at a certain level of exposure to a harmful agent, it is common practice to set a standard that provides a substantially lower level of exposure as a safety margin to assure that human health is protected. This is because of the inability of the reserach methodology to

FIGURE 2

Location of the Proposed Crossfire Development and the Kaiser Cement Limestone Mine in Relation to the Board Approved Corridor



- - - - - Boundary of Board-approved two mile-wide corridor

•••••• MPC proposed centerline

▨ Proposed Crossfire development

▧ Kaiser Cement limestone mine

precisely determine effects, problems with transferring research findings from animals to people, and the generally conservative approach that is taken when dealing with human health. For example, if harmful effects to animals were demonstrated at a level of 100 parts per million (ppm) of a certain chemical, some effects that the research method cannot detect might be presumed to occur at 20 ppm. A standard might be set at 2 ppm to provide a safety margin. Another way risk can be reduced is by decreasing time of exposure. In the case of electrical effects of transmission lines, this is done by ensuring that people do not live under or immediately adjacent to power lines. Determining the width of a right-of-way, considering life-of-project land use, becomes a key issue (see Appendix C).

Implications to Human Health of Electric Fields

Scientists disagree about the extent of risk associated with transmission lines. DNRC basically agrees with the findings described in Appendix C for a 765 kV line that few effects have been demonstrated. However, more recent research has more clearly demonstrated that low-level biological effects exist, (Exhibit 31B, Rogers et al 1981, Phillips 1981, Nordstrom et al 1981, Anderson 1982, Kaune and Phillips 1981). These studies are not yet complete but do indicate that there is a need for caution when locating new residences within electric fields. It should also be noted that the studies do not indicate the extent of risk or of harmful impact to people of the low-level effects.

One of the main studies that has been undertaken and that directly attempts to assess biological effects in a manner that would be useful for assessing risk to people is being conducted for BPA by Battelle Pacific Northwest Laboratories. Miniature swine, a strain especially bred for laboratory use, are being used in this experiment. There were some indications of adverse physiological changes at electrical fields of 30 kilovolts per meter (kV/m), but the physiological mechanism for these changes is not known (Phillips 1981). BPA's Townsend-Garrison line is, at the highest, 7-9 kV/m, under the lowest part of the span of the line. The findings have been questioned because of disease in the experimental animals. However, a Battelle researcher recently reported a definite link to small changes in the nervous system of swine in this experiment (Anderson 1982). Since an effect on the nervous system, even though small, would affect an animal's response to its environment -- its behavior -- this result would be significant.

The researchers conducting the swine study at Battelle have found that electrical fields vary according to body size and shape. For example, surface electrical fields at the top of a person's body increased by a factor of 17 times over the unperturbed field strength measured before the person entered the electric field (Kaune and Phillips 1981). According to BPA, the electrical field at the edge of their proposed 125-foot right-of-way is calculated at about 1.8 kV/m for flat terrain, although the field can vary slightly according to the presence of objects and topography (Reiner 1982). Research tends to indicate that the 1.8 kV/m figure may not be an accurate measurement of the actual exposure to people, and that at worst the actual electric field exposure for people at the edge of the right-of-way may reach levels where low-level effects were observed on swine (Kaune 1982).

Another recent BPA report on BPA's Lyons 1100 kV test facility finds that while there were no gross changes in terms of movement patterns, "there may have been a subtle movement of cattle away from the line after energization." (Rogers et al, 1981). Some of these movements were statistically correllated with electrical field levels, but other causative factors -- such as noise -- were not ruled out. The highest electrical field strength at 1 meter above the ground under the test line was 12 kV/m, about 40 percent higher than the proposed 500 kV line.

The reports discussed above indicate that electric field levels at the edge of BPA's proposed 125-foot right-of-way are close to levels at which low-level biological effects might be expected to occur in people if people lived there. This leaves an insufficient margin of safety, and indicates that BPA should consider precluding the construction of residences immediately adjacent to their right-of-way (see Section IV). Based on the evidence available to DNRC at this time, an adequate safety margin would be provided by avoiding existing residences within 137.5 feet of the centerline (275 ft right-of-way). At this point the electric field level would be approximately 0.3 kV/m (Reiner 1982). Further human health risk assessment also should be made to determine a threshold level that could be used as an edge-of-right-of-way standard (see also discussion of noise impacts).

Ecological Studies of Honeybees

Testimony was presented at the Board's hearing that BPA's line could adversely affect honeybee hives located on or near the right-of-way. (Paul Peterson testimony, Exhibit 31(B), Rogers et al 1981). The referenced reports are BPA-sponsored research that was not available to DNRC at the time its draft report was prepared.

The reports concern ongoing experimental studies at BPA's prototype test line near Lyons, Oregon. The studies confirm other findings (Greenberg et al, 1978) of significant adverse effects (hive failure) at electrical field strengths of 7-8 kV/m, comparable to that found under the lowest part of the span on the proposed line. The observed effects were increased aggressiveness and irritability, queen loss, failure to produce honey, and high rates of deposition of propolis, a substance thought to be used as a defense.

Not all of the conclusions presented in the reports were available at the time BPA prepared its FEIS supplement; however, since BPA was aware that the ongoing research was demonstrating adverse effects in 1980, BPA should have integrated the research findings into its discussion of potential impacts.

In its FEIS supplement, BPA suggests that the mechanism for adverse effects on bees is "mini-shocks" caused by induced currents that can be eliminated by shielding the hives (USDI 1981a, Appendix C). This statement can be traced to Greenberg et al 1978, where it is called only "plausible." The statement is not fully supported by either of the Rogers et al studies (Rogers et al 1980, 1981), because hives that are shielded still show some adverse effects, and Rogers et al (1981, pg. 28) found that increased irritability can occur at all hives near the line. The report concludes that further research is needed with hives at 0, 2, 4, 6, 8, and 11 kV/m locations. The observation that bees were irritable in all hives located within electrical fields was confirmed by Battelle Pacific Northwest researchers, although they had difficulty quantifying the observations (Burgett 1982, Gano 1982). Extrapolation of the results of the Lyons studies would mean that BPA should consider impacts that might occur to bees flying through electrical fields, i.e., severe adverse effects are clearly demonstrated but the physiological mechanism is not known.

Control hives at BPA's Lyons test facility are located within 650 feet of the centerline, and are, according to BPA's studies, exposed to electrical fields. Any bees foraging from control hives to locations beyond the line would be flying through fields higher than 12 kV/m. According to Rogers et al (1980) electrical fields at the location of the control hives increased from 0.2 kV/m in 1977 and 1978 to 0.4 kV/m in 1979 when the lines were lowered to increase the field strength directly under the line from 7 kV/m to 12 kV/m. Therefore, there is no true "control" hive. It should be noted that this was not necessarily a defect in experimental design, because the experiment was designed to first detect more gross effects. The latest studies suggest that hive locations be changed, and that bee flight studies be conducted (Rogers et al 1981).

BPA provides no discussion in the FEIS Supplement beyond presentation of some of the adverse impacts to bees. BPA has not applied the findings of the honeybee research to western Montana, nor to centerline selection, and has made no attempt to determine the economic impact to beekeepers of the hives being located in certain places. If a line were routed through a narrow valley, it seems reasonable, as Mr. Peterson pointed out in his testimony, that hives located nearby might be affected. It is likely that relatively simple mitigation measures would take care of most problems because, while severe effects are demonstrated, they appear likely to decline to low levels away from the line.

Audible Noise Impacts

DNRC's draft report expressed concern that BPA's right-of-way may be too narrow with respect to potential noise impacts. The discussion in Appendix C explains the issues involved. Noise from BPA's line would be at a level that could potentially cause impacts only during rain or fog. The potential impact would only concern future housing development close to the line because present houses can be avoided by appropriate centerline placement. Hearings before the New York Public Service

Commission found that the highest potential impact from transmission line noise was in rural areas, and sleep disturbance could result in some cases as far as 500 feet from the right-of-way (Herrold 1979, Scott-Walton et al. 1979). Subsequently, the New York PSC required that the utility resolve complaints of residents living within 600 feet of the 765 kV line (Herrold 1979). In Minnestoa, noise is described as a possible limiting design factor for high voltage transmission lines (Banks 1977).

During foul weather, which is when the noise from any transmission line is greatest, the noise from the 765 kV line is only slightly higher than is BPA's proposed line. Assuming rain or heavy fog for a 24-hour period, the average day-night noise level of the 765 kV line was 58 decibels (dBA) as compared to 57 dBA for BPA's line (see Appendix C). As discussed in Appendix C, effects of transmission line noise in a previously quiet environment might be severe, and most noise research is not applicable to rural and/or quiet environments. The Environmental Protection Agency (EPA) has attempted to estimate impacts by using correction factors that adjust measured noise levels upward or downward based on the environment of the line. The presence of three of these situations, a rural community, people who have not previously experienced the intruding noise, and the pure tone characteristics of transmission line noise -- would mean that BPA's measured noise level (of 51 dBA) should be increased to 71 dBA in order to estimate impacts in these environments (Scott-Walton et al. 1979). This indicates that BPA's right-of-way width of 125 feet is not sufficient to prevent noise impacts to people living next to the line. In some cases, transmission line noise is caused by damaged conductors; BPA will repair them if this is the case. But most noise during foul weather cannot be mitigated because of the pure tone characteristics of the sound. While some impacts may occur several hundred feet from the centerline under some circumstances, DNRC finds that avoiding residences within 137.5 feet of the centerline will reduce impacts to an acceptable level.

LAND USE CONCERNS

A number of route or site specific concerns relating to land use were raised during the Board's hearing, including land use changes along the Helena route since 1976 when part of this route between Helena and Garrison was originally evaluated by the Board. A need for detailed information in areas with particularly complex land use patterns, such as the Missouri and Clark Fork River valleys was also identified. Additional information addressing these concerns is presented in the following subsections.

Land Use Changes in the Helena Route

There have been a considerable number of changes in land use patterns along the Helena route since the Board approved this portion of the route as part of its certification of the Colstrip project in 1976. Figure 1 shows the location of this route. Most of the land use changes are due to residential development in the Townsend and Helena areas. The major changes are described below, beginning at the BPA takeoff point at Townsend and progressing northwestward.

In the vicinity of the Missouri River crossing, there has been a substantial increase in the amount of sprinkler irrigation, including creation of two new center pivot systems. These changes are more fully described in the "Missouri River Crossing" section of this report (see also Figure 3).

The Limestone Hills National Guard Gunnery Range is crossed by the corridor southwest of Townsend (see Figure 3). Montana Power Company was in the process of investigating possible corridor changes to the east of this range at the time BPA took over the project.

Between Townsend and East Helena, several new subdivisions have been created and many new homes have been constructed since 1976. The corridor crosses the Antelope Estates subdivision located upslope from the railroad tracks in the SE-1/4 of S33 T8N R1E. This subdivision consists of 20.8 acres divided into one-acre lots. The Tom Campbell subdivision (S22 and 23, T7N, R1E) would also be crossed.

The route would pass over the Koppen Mining Co. mill and tailings pond south of Winston (S13 T8N R1W) which was recently approved by the Department of State Lands and the Kaiser Cement limestone mine SE of Helena (see Figure 2).

A major proposed subdivision, the Crossfire Development, is planned SE of Helena (see Figure 2) in T9N R3W. It is bisected by the route which crosses Interstate Highway 15 as it crosses the subdivision. The developer has published a community development plan which calls for a complete city at the site with offices, schools, parks, houses, natural areas, golf course, etc. The route passes within 1/4 mile of the community core. The plan was published in 1979 after the Board approved the Helena route and is called the "Crossfire" Plan. The plan projects an ability to eventually accommodate 38,000 people but no work is in progress to develop it at this time. The Areawide Planning Organization in Helena reports that a realistic timetable for development of this general area would see development of about 1600 dwelling units, with about 4600 persons in residence by the year 2000. Full development would probably not occur for 30 years or more (Byrom 1982).

A number of new homes in the Helena area would be affected by the route, particularly outside of East Helena (S33 T9N R1W), in Dry Gulch south of Helena, and near the Highway 12 crossing west of Helena. The Broadwater Athletic Club, which was recently built on Highway 12, would be within about 1/2 mile of the Highway 12 crossing.

MAJOR RIVER VALLEY CROSSINGS

In two areas along the three alternative routes--the Clark Fork crossing along the original Boulder-Deer Lodge route and the alternative Missouri River crossings--complex residential and agricultural land use patterns, as well as other values such as wildlife and recreation, pose an important risk for adverse impact and deserve special attention. In both areas, it is impossible to site the proposed line without having some impact on residences and agriculture. DNRC's objective was to find a centerline which would have the least overall adverse impact on residences, agriculture, and other aspects of the human and natural environments while acknowledging that a "zero-impact" centerline cannot be found. BPA apparently did not produce detailed maps of these areas, although such maps are necessary for mitigation through centerline adjustment as well as for an accurate appraisal of the actual impacts of a particular route. This appraisal is important since, in many cases, centerline selection can substantially reduce actual impacts below those predicted for a generalized two-mile-wide corridor. In order to evaluate possible mitigation through centerline location, and to assess the severity of the net impacts it might not be possible to mitigate in these areas, DNRC prepared detailed land use maps of the two areas (see Figures 3 and 4) as described below.

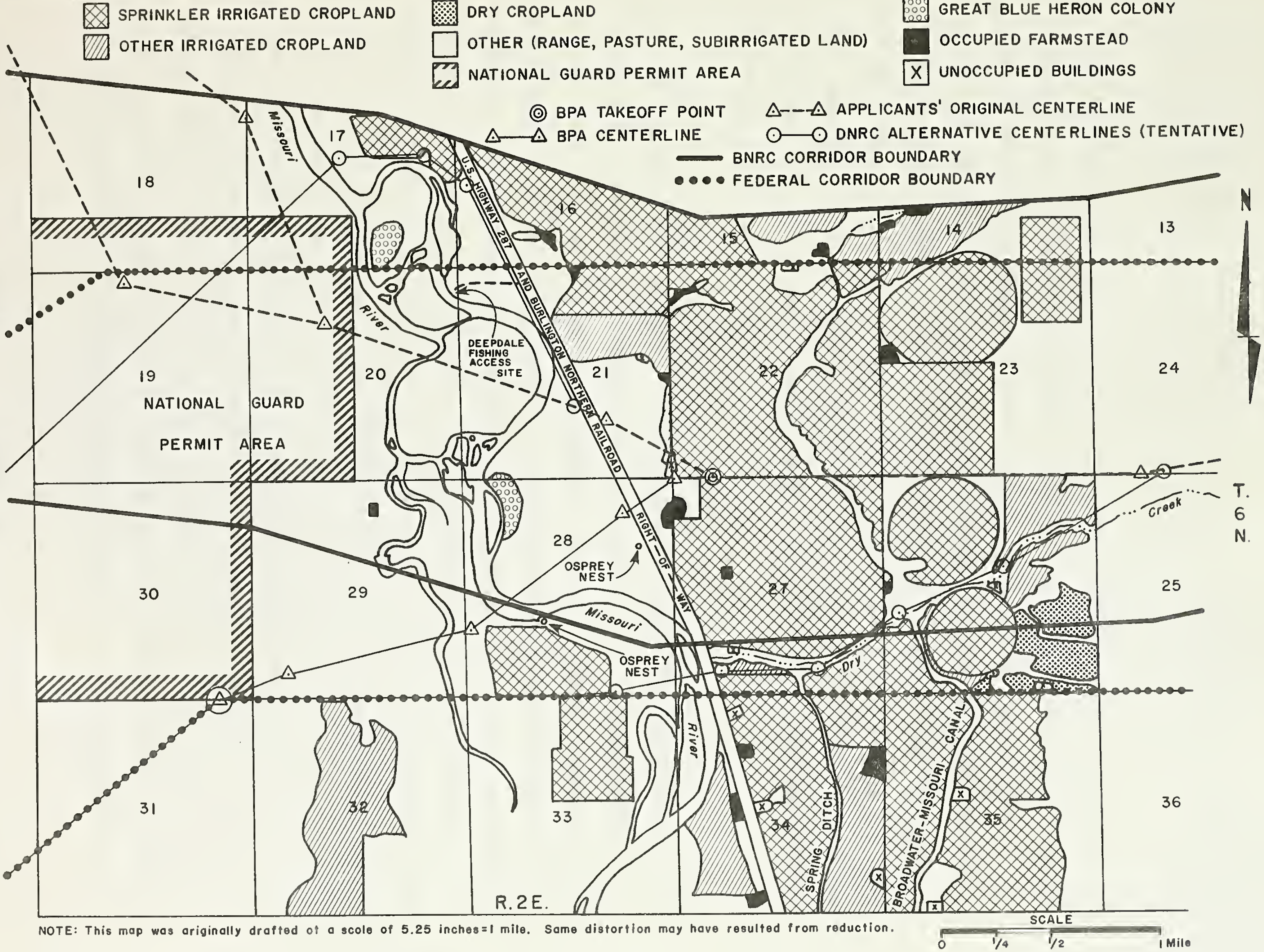
Alternative Missouri River Crossings

In its 1978 centerline evaluation and report to the Board, DNRC identified the vicinity of the Missouri River crossing south of Townsend as one of the most sensitive areas along the entire route between Colstrip and Townsend. This was due to the juxtaposition of critical wildlife values, a high recreational use area, relatively dense residential development, and intensive agricultural development, including large sprinkler irrigation systems (DNRC 1978).

The centerline proposed by Montana Power Company would have crossed a very large island just south of the Deepdale Fishing Access site and would have proceeded northwestward toward Helena (see Figure 3) Because of the ecological, recreational and visual values associated with the large group of islands in this area -- the largest group of islands in the free-flowing Missouri River west of the Montana-North Dakota border -- DNRC investigated alternative crossing sites to the north of these islands. As part of this anlaysis, a detailed land use map of the corridor and adjacent areas was prepared and included in the centerline report (DNRC 1978).

In 1978 BPA announced that it would be constructing the Colstrip lines west of Townsend. The September 1979 Record of Decision indicated that a new corridor, crossing the river farther south toward Radersburg, would be followed. Although DNRC had not studied the area south of the Board-approved route in detail, and although DNRC was no longer directly involved in decisions regarding the location of the crossing, there were sufficient data available to indicate that there could be

SOURCE: Originally mapped in 1978 from aerial photography provided by the USDA AGRICULTURAL STABILIZATION and CONSERVATION SERVICE, Townsend, Montana. Updated and field checked May 5 and 17, 1982


▨ SPRINKLER IRRIGATED CROPLAND
▨ OTHER IRRIGATED CROPLAND
▨ DRY CROPLAND
☐ OTHER (RANGE, PASTURE, SUBIRRIGATED LAND)
▨ NATIONAL GUARD PERMIT AREA
▨ GREAT BLUE HERON COLONY
■ OCCUPIED FARMSTEAD
☒ UNOCCUPIED BUILDINGS
◎ BPA TAKEOFF POINT
△—△ BPA CENTERLINE
△- - -△ APPLICANTS' ORIGINAL CENTERLINE
⊙—⊙ DNRC ALTERNATIVE CENTERLINES (TENTATIVE)
— BNRC CORRIDOR BOUNDARY
●●●● FEDERAL CORRIDOR BOUNDARY
N
13
14
15
16
17
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19
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23
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29
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31
32
33
34
35
36
NATIONAL GUARD PERMIT AREA
Missouri
River
DEEPDALE FISHING ACCESS SITE
U.S. HIGHWAY 287 AND BURLINGTON NORTHERN RAILROAD RIGHT-OF-WAY
OSPREY NEST
OSPREY NEST
Missouri
River
Creek
Dry
SPRING DITCH
BROADWATER-MISSOURI CANAL
T. 6 N.
R. 2 E.
SCALE
0
1/4
1/2
1 Mile

NOTE: This map was originally drafted at a scale of 5.25 inches=1 mile. Some distortion may have resulted from reduction.

FIGURE 3. Alternative Centerlines in the Missouri River Crossing Area

severe problems with a line located in this area, and DNRC expressed its concern to BPA and the U.S. Fish and Wildlife Service (USFWS).

The reasons for concern were many. In addition to the complex land use patterns noted above, the stretch of the Missouri River which is crossed is heavily-used by floaters, fishermen, hunters, and other recreationists. According to figures provided by the Montana Department of Fish, Wildlife and Parks approximately 2400 visitors used the Deepdale fishing access site from May 25 - September 30, 1981 (Pacini 1982). Many persons using this stretch of river are floaters who put in at Toston and take out of the river at Deepdale. The location of the transmission line crossing would greatly affect the visual quality of the recreational experience of floating this stretch of river.

The federal corridor crossing also includes some of the most sensitive wildlife habitat between Toston and Townsend. The outstanding wildlife values of this stretch of river contribute to its recreational value. The banks of the river are lined over most of its length with high-quality stands of mature cottonwood forest, which are used as perch trees by wintering bald eagles (this area is known as the "Holker Roost site) and which provide habitat for the most diverse wildlife communities in the area. Two great blue heron colonies and at least two osprey nest sites are located in the area. The southern heron colony is expanding southward, and double-crested cormorants began nesting in the colony in 1982. West of the river is a warm water slough ("Stanfill's Slough") which provides critical open-water habitat for waterfowl during the winter months. The river itself is heavily used as a travel corridor by ducks, geese, herons, and other water birds which fly up and down the river during feeding flights or while flying to or from the Canyon Ferry Waterfowl Management area located about six miles downstream.

For these reasons, DNRC, MDFWP and USFWS were concerned that a centerline be carefully chosen so as to minimize the many adverse impacts which would occur in this critical area. This concern grew when it became apparent that BPA was not mapping the land use patterns and other concerns in the federal corridor in detail, and was considering crossing the river at one of the worst possible places. DNRC expressed this concern to BPA (see Exhibit 21), but the presently proposed crossing was finally chosen in spite of objections from DNRC and the USFWS. In its letter of Biological Opinion dated April 10, 1981 (See Appendix D), the USFWS stated that "With regard to the bald eagle as well as other wildlife species, BPA has selected as the crossing site one of the most sensitive locations between Townsend and Toston...The FWS believes that relocation of the crossing combined with changes in tower design will substantially reduce all of the impacts discussed above. (The line should be relocated to avoid the Holker Roost and Stanfill's Slough.) A site approximately one mile south of the present proposed location (as recommended by the Montana Department of Natural Resources) should be considered. The suitability of other locations should be discussed with FWS and DNRC." BPA, however, rejected these recommendations, on the assumption that the more southerly crossing "would cross more farmland, including proposed circle irrigation systems and would not allow retention of any more riparian habitat" (USDI 1982c, p. IV-5). Faced with this decision, DNRC and other concerned agencies focussed their attention on how to mitigate the severe impacts which would result from the BPA crossing site, in an attempt to make the best of an unacceptable situation, while maintaining that relocation would provide the only really satisfactory mitigation. On September 3, 1981, representatives of the agencies met at the site to agree on ways to attempt to otherwise mitigate the impacts.

DNRC has re-investigated the Missouri River crossing vicinity, updated the 1978 land use map, and produced the necessary land use mapping of the federal corridor and adjacent areas. This map is included herein, at a greatly reduced scale, as Figure 3. This map shows the location of the Board's approved two-mile-wide corridor (MPC 1977) as well as the federal-approved two-mile-wide corridor (USDI 1982c). Land use data were obtained from the Townsend ASCS office aerial photographs and field checked with affected landowners.

A number of significant changes have occurred in this area since DNRC's 1978 analysis. Several new sprinkler irrigation systems, including center pivot systems, have been installed, and some new residences have been constructed. A new great blue heron colony has been discovered, and a new osprey nest located.

Based on this mapping, DNRC attempted to identify the centerline crossing of the Missouri River which would have the least impact on the human and natural environment. It appears that a centerline could be located within the state and federal approved corridors which would have less impact on nearly every concern than would the BPA centerline as shown by Table 2. This centerline location has not been subjected to an engineering analysis and therefore exact placement of the towers is not portrayed on Figure 3. Some changes may be necessary to accommodate engineering concerns and possibly reduce impacts even further.

The DNRC tentative southern centerline location is shown in Figure 3 and is compared with the original BPA centerline in Table 2 The DNRC reroute, which is within the Federal corridor, would pass between two center pivot irrigation systems but would not interfere with their operation. It generally follows the Dry Creek channel, which is not cultivated, and follow the edge of a sprinkler-irrigated field to the Missouri River. It crosses the river at the point where the river passes immediately adjacent to the railroad and highway and passes through a gap in the cottonwood forest so that no clearing of mature cottonwood trees would be required. West of the river, the line would follow a section line along the boundary between two sprinkler-irrigated fields for a short distance. The line would avoid the heron colony and the two active osprey nests, and would pass near (within 1/4 mile) of only one currently occupied house. It would cross the warm water slough east of the river at a point where the slough is more narrow and probably used less by waterfowl. The visual intrusion of the line crossing the river would probably have less effect on persons floating the river than would the BPA crossing since it would cross at an already heavily disturbed site adjacent to the railroad and highway. Based on DNRC's land use mapping, and on a "worst-case" assumption that no more than six towers would be required per mile (according to BPA, the average number per mile would be 4.5), the DNRC route would result in fewer towers on irrigated land, and -- more importantly -- less than a third as many towers on sprinkler irrigated land. Waterfowl losses could be reduced further by extending the amount of twin single-circuit line construction to a point west of the river channel. The USFWS recommended that BPA cross the river with two single circuit lines rather than double-circuit in order to reduce the "strike zone" for wildlife. This possibility is included in the third column of Table 2 (also see Appendix D); however, it would result in several additional towers on irrigated land.

DNRC also evaluated an alternative Missouri River crossing north of the Deepdale Fishing access site (see Figure 3, and Table 2). While this route would avoid the most sensitive riparian areas, it would affect slightly more irrigated land and would be about 1.4 miles longer than the other routes. It would cross near the center of the National Guard Gunnery area; while this would not be a serious problem to Guard operations, the Guard would require aircraft warning balls to be installed on the static wires (Wood 1982; Rodman 1982). This route would pass between the river and a warm water slough located in the north-central portions of Section 21. Also, a longer portion of the line would be in the vicinity of the river, and would therefore present a higher waterfowl collision hazard.

DNRC concludes that the BPA proposed crossing may not comply with the substantive standards of the MFSA, since at least one other centerline exists within the federal corridor which has substantially less adverse impact on the human and natural environment.

If the Board relocates the centerline in this area, BPA's river crossing permit from the Army Corps of Engineers would have to be amended, and the Board would have to approve a different centerline within its approved corridor and a new BPA tie-in point with Montana Power Company. The tie-in point could be moved east to the eastern juncture of the present MPC centerline and the southern centerline alternative identified by DNRC in Figure 3. The Corps has indicated that approximately 45-60 days would be required to process an amendment to BPA's permit for a new river crossing in this area (Miller 1982).

Table 2. Comparison of Missouri River Crossings.

	BPA	DNRC Tentative Southern C/L (With Double-Circuit Construction Beginning at southern edge of DNRC Corridor	DNRC Tentative Southern C/L (With Double-Circuit Construction beginning just west of the river crossing	DNRC Tentative Northern C/L
Approximate length (miles) Dry Creek-Radersburg	10.9	10.9	10.9	12.3
No. Heron colonies within 1/4 mile	1	0	0	0
No. Osprey nests within 1/4 mile	2	0	0	0
Approximate amount of mature cottonwood forest clearing required, acres	1	0	0	1
No. residences within 1/4 mile	2	2[1]	2[1]	2
Approx. No. towers on irrigated land	12	11	13	13
Approx. No. towers on sprinkler-irrigated land	11	3	5	12
River characteristics at crossing site	Natural; > 1/2 mile from highway	Adjacent to RR and highway	Adjacent to RR and highway	Natural; >1/2 mile from highway
Waterfowl collision hazard	High	Low	Moderate	High

[1] One of these residences is currently unoccupied

Underground Cable Installation

One possible means of almost completely mitigating visual, recreational, land use, and wildlife impacts at the Missouri River Crossing would be through use of underground cables rather than overhead lines at the crossing site. In its draft EIS on the Garrison-Spokane project, (USDOE 1982a, Appendix E), BPA considered the possibility of underground cable installation at two sites in the Missoula area, but has not considered this option anywhere along the Townsend-Garrison route. The following discussion of underground cables is derived primarily from Appendix E of the Garrison-Spokane EIS and from discussions with BPA (Nichols 1982).

Of the various types of underground transmission facilities currently available, BPA has found the self-contained oil filled cable system (SCOF) "to meet BPA's reliability criteria best and to be least expensive." (USDOE 1982a, Appendix E, p. 1). For a double-circuit 500 kV system, this would require seven, 4-5" diameter cables spaced 1-2' apart and buried 3-4' deep. At major river crossings, the cables could be installed by trenching, which would disturb a strip of river bank and bottom about 15' wide, or the cables could be placed by a special underwater machine developed in Europe for laying cables on the ocean bottom. At the two termination points between the underground and overhead lines, substation-like facilities would be necessary, including surge tanks (to allow for expansion of the oil in the cables), porcelain potheads at the entry point into the ground, and a surge corrector device. Pumping or compressor stations are apparently not required for SCOF systems. Very few such systems are in place in the U.S.; SCOF has been used for a 1500' segment of a four-circuit 500 kV U.S. Bureau of Reclamation line at Grand Coulee Dam, but most of the technology comes from England and Japan, and considerable lead time would be required in engineering and procurement of materials.

The two major problems with underground cable installation at the Missouri River crossing are (1) the long lead times required for engineering and material procurement, which would delay the project substantially, and (2) cost.

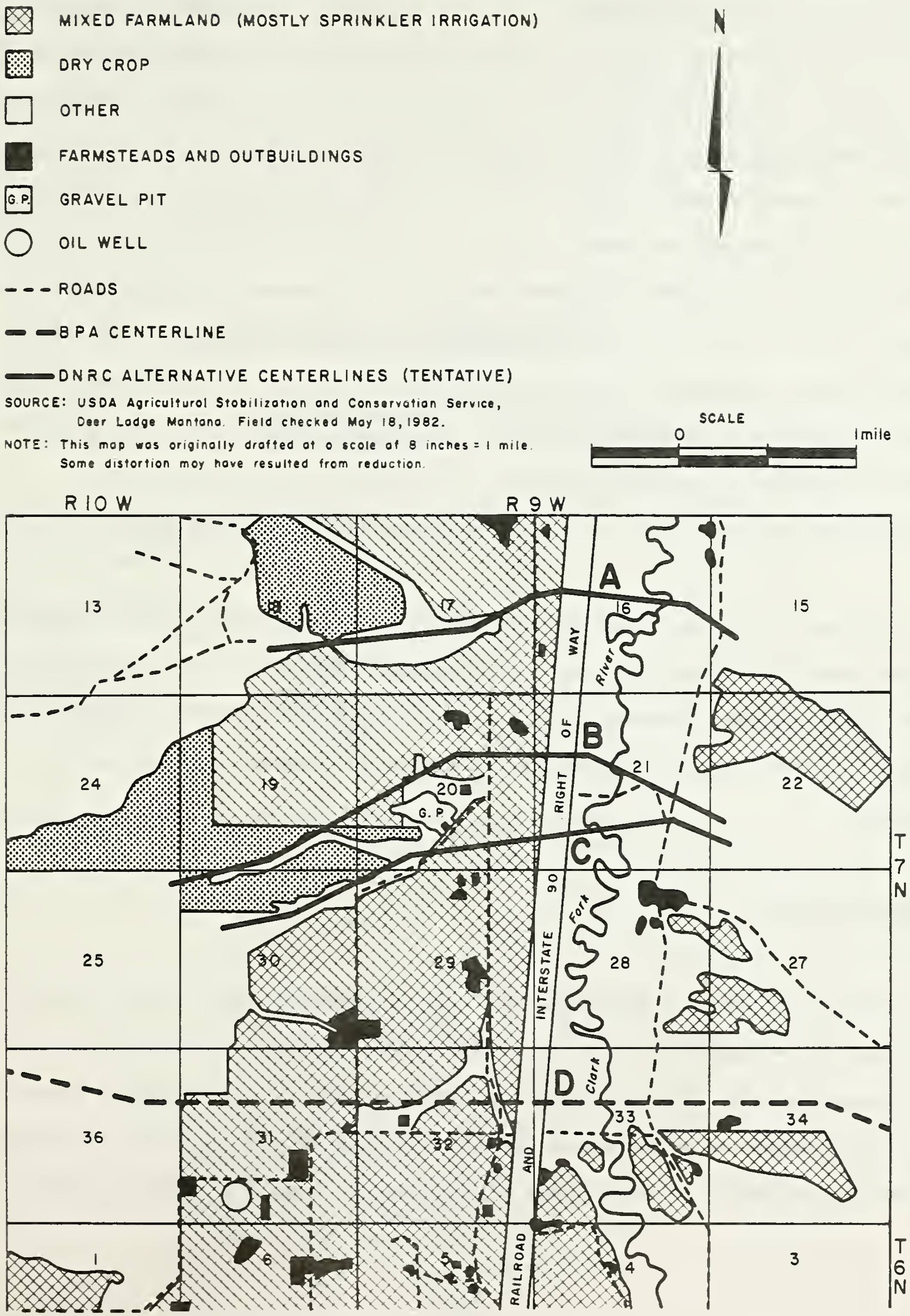
Reliable cost estimates for underground transmission are difficult to obtain, but underground costs are higher than overhead by a ratio of about 10 to 1. According to BPA, 2.9 miles of underground construction in the Rattlesnake area near Missoula would cost $21.6 million (about $7.4 million per mile), and 4.5 miles near Lolo would cost $32.1 million (about $7.1 million per mile) (USDOE 1982a, Appendix E, p. 2). In comparison, the construction cost for the BPA Final Route from Townsend-Garrison is $688,000 per mile (Eddy 1982a).

In the Missouri River area, about 4 miles of underground line would be necessary to cross the entire river floodplain and all irrigated land, but substantial benefits could be achieved if as little as 1.3 miles were built underground. Trenching depth would depend on river scour depth, and would probably need to be greater than 4'. However, at the present time, underground construction does not appear to be cost-effective. Full mitigation of impacts could probably be better achieved by compensation (e.g., providing substitute recreational, and wildlife lands and fully compensating landowners to offset any losses incurred) than by underground construction.

Clark Fork River Crossing (Original Boulder-Deer Lodge Route)

Figure 4 shows land use patterns in the vicinity of the Clark Fork River crossing near the Original Boulder-Deer Lodge Route. BPA's centerline for this route plus several tentative DNRC centerlines are shown in this figure. The centerline for the BPA Final Route across the north end of the valley is not shown on the figure. Also, because the figure is intended only to examine alternative centerlines through the area immediately surrounding the river, the lines are not extended east and west. Measures of the impacts are compared in Table 3. For all the centerlines included in Figure 4, the risk of transmission line wire strikes by waterfowl and other birds is moderate. Birds from a waterfowl production area 10 miles south of the area as well as resident water birds, would be likely to strike the wires while flying along the river or to and from feeding areas. DNRC identified two possible centerlines, A and B, which would have less adverse impact on agricultural production and on residences than the centerline identified by BPA as part of its original BDL Route (Alternative D in Figure 4). Centerline B crosses near a gravel pit where a transmission line would be less visually intrusive. Centerlines A and B cross state land in sections 19, 24, 25 and 30. Two or fewer residences would be located within 1/4 mile of either of these centerlines. The amount of cropland that would be taken out of production by the tower bases is minimal and could be fully compensated by BPA. Some interference with sprinkler irrigation systems could occur but is at least partially mitigable (Varner and Patel 1982; Henderson and Scott 1981; Malefyt 1981). Alternative centerline C is intermediate in impact between alternatives A or B and BPA's original proposed crossing of the Clark Fork.

FIGURE 4.
Alternative Clark Fork River Crossings



SOURCE: USDA Agricultural Stabilization and Conservation Service, Deer Lodge Montana. Field checked May 18, 1982.

NOTE: This map was originally drafted at a scale of 8 inches = 1 mile. Some distortion may have resulted from reduction.

DNRC examined 8" = 1 mile aerial photos and conducted a field inspection of the vicinity of BPA's final proposed centerline crossing of the Clark Fork north of Deer Lodge (not shown in Figure 4) and concludes that impacts to existing residential and agricultural land use would be minor along this centerline as well. Much of the opposition to the Clark Fork crossing of the Original Boulder-Deer Lodge route was due to the visual impact of this route on residences and travelers in the Deer Lodge Valley. All alternatives shown in Figure 4 would very nearly bisect the valley and would be visible for great distances upstream and downstream. The BPA Final Route would be less visible from the valley and the town of Deer Lodge. The entire area shown in Figure 4 except for the northern tier of sections 13, 15, 17 and 18 lies within the corridor studied in the Final Supplement. Centerline C is similar to a possible centerline location identified by the federal study team within "alternative corridor B" in the Final Supplement (Figure 4, USDI 1981a).

DNRC concludes that siting the line near the Original Boulder-Deer Lodge route in the Clark Fork River area, and proceeding to a substation site either west of Deer Lodge (original proposed site) or near Garrison (as presently proposed) (see Figure 8), cannot be ruled out as an option based on residential and land use impacts.

Future Land Use

At both the Missouri River and Clark Fork crossings, some types of future land use would be precluded or inhibited regardless of line location. Future sprinkler irrigation systems, including center pivots, are possible in almost the entire floodplain areas. A center pivot could possibly by located in the southeastern corner of Section 27 across the Dry Creek channel. Special mitigating measures would be necessary to deal with this type of impact, e.g., substitution at the expense of BPA of alternative systems or monetary compensation to landowners by BPA for lost opportunities. Residential and other construction would be prevented within the right-of-way and, although construction near the right-of-way would still be possible, it would have certain disadvantages (see previous discussion in this section on noise and health effects).

TABLE 3. COMPARISON OF ALTERNATIVE CENTERLINES IN THE AREA SOUTH OF DEER LODGE

	DNRC ALTERNATIVE CENTERLINES			BPA CENTERLINE
	A	B	C	D
No. towers on Mixed Farmland[1] (mostly irrigated)	2	8	4	9
No. towers on Dry Cropland[1]	0	1	0	0
No. Residences within 1/4 mile	0	2	3	5

[1] Assuming the number of towers/mile will be no more than 6.

BPA has not finished compliance with the Historic Preservation Act or with 36CFR800, which define the procedures for complying with the Act. Appendix E, a letter from the Montana Historic Preservation Office (SHPO) to BPA dated May 14, 1982, defines the status of the impact review.

The SHPO determined the effects of the transmission line on cultural resources could include: visual impacts, increased vandalism during construction, increased vandalism due to greater public access, noise, and actual destruction of sites by construction activities.

Cultural resource consultants for BPA have recommended a finding of no adverse effect on the Gray Eagle Mine Complex, Comet Mining Town, the Boulder Lime Kiln, the Morning Glory Mine Complex, two archaeological sites, and two homestead sites, Efraimson and Zimmerman. The consultants further recommend that the portions of the Mullan Road crossed by the line are not eligible for listing on the National Register of Historic Places, and therefore not worthy of further consideration.

The SHPO has conditionally accepted BPA findings provided that they document photographically that there would be no adverse visual intrusion; monitor or protect the sites during construction; ensure the construction contractor is bonded to protect historic properties from employee vandalism or destruction; move the line at Comet should that town be visually impacted; and limit access by maintaining gates. (See Appendix E for specific recommendations on each site). The SHPO disagreed, however, with the finding that the Mullan Road is not eligible for the National Register. The SHPO has requested the Keeper of the Register to make an official determination as to whether those segments of the road are eligible.

The SHPO has requested BPA to forward information necessary to determine whether adverse effects would occur to historic properties as a result of fire caused by sparks from the line or from blasting during construction, whether construction activities would occur outside of areas inventoried for historic and archaeological properties, and what visual impacts would occur. The SHPO also asked whether visual impacts would occur to sites not yet evaluated by BPA, specifically those identified in the 1981 overview (Choquette et al. 1981), the Red Rock Ranch, Boulder Hot Springs, and the Grant Kohrs Ranch.

Helena Route Analysis

The Bureau of Land Management provided DNRC with maps indicating the location of historic and archaeological sites considered in the TER corridor selection process. A list of each site and the ranking or score given each one could not be located. Sites identified within 6 miles of the corridor were given impact scores. However, sites such as the Heffner Ranch which is near the Helena Route have been listed on the National Register of Historic Places since the TER was done. Also, as noted in DNRC's draft report, no centerline study was conducted to identify all sites, as was done on the BPA Final Route. It appears that impacts on the Helena Route were overrated in the TER. Sites in the Helena Historic District would not be likely to be impacted by the line, but they contributed to the high impact score the Helena Route was given since the district falls within 6 miles of the route.

A valid comparison between alternative routes is complicated by the fact that additional sites have been identified on the BPA Final Route, due to the surveys performed for that route, which were not considered in the TER study. It is likely the BPA Final Route score would have a somewhat higher impact score and the Helena Route a somewhat lower score than that given in the TER, based on the most current information.

ICING HAZARD

In the discussion of various alternative routes, BPA's FEIS supplement (USDI 1981a) presents the number of miles of each route which lie above 6500 feet elevation. The implication was that above this elevation there is a greater icing hazard and stronger towers and shorter spans are required. During the Board's hearing BPA submitted Exihibit 31A entitled "Rationale for Heavy and Severe Icing Areas" to explain its treatment of this concern.

There are several mechanisms by which ice or snow can build up to amounts which can damage transmission lines. Except for hoar frost, which is not much of a hazard, icing requires temperatures near the freezing point and some form of precipitation or fog. Depending on the temperatures and form of moisture involved, different kinds of ice can form on the conductors. A large accumulation adds weight and wind resistance to the line which converts to vertical and horizontal stresses on the towers. Under severe conditions, conductors may break or towers may collapse, resulting in power outages and expensive repairs. Therefore, lines should be designed to withstand probable wind and ice loading.

All areas in Montana are subject to icing but, presumably, the risk is greater in some areas than others. It is unclear whether climate was a factor in BPA's route comparison and selection. The Colstrip DEIS states that "All alternative corridors pass through the geographic areas most susceptible to icing and high winds...there are no data to reliably pinpoint problem zones and make meaningful comparisons of the icing impact potential among corridors" (USDI 1979a, p. 3.2-4). As discussed below, the climate of the mountains in Montana is relatively unknown, and any assessment of meteorological hazards must, by necessity, be based on unproven assumptions.

BPA Exhibit 31A is based on a report done by Meteorology Research, Inc. (MRI 1979) on meteorological factors on the Board-approved route for the 500 kV line from Broadview to Hot Springs, but not routes through the Boulder-Deer Lodge area. The Board-approved route was divided in 35 segments. Icing and wind loading were two of the factors examined. The icing "areas" of Exhibit 31A are defined only on the basis of elevation. Exhibit 31A states, "Based on the limited data from the report...BPA engineers selected the following criteria for expected ice loading on BPA's corridor:

Up to 5500 feet - 1/2 inch radial ice (standard)
5500 ft to 6500 ft - 3/4 inch radial ice (heavy)
Above 6500 ft - 1 inch radial ice (severe)"

DNRC believes that it is not possible to derive these criteria directly from the MRI report. The MRI report does not establish a relationship between elevation and icing potential. A meteorological study of this type, done after the route was chosen (March 1979), is useful only in the design of the line; not in line siting. No new data were gathered or conditions evaluated for the Townsend to Garrison route. BPA has indicated that they have little meteorological information for areas this far east; therefore, their assumptions on icing and other meteorological hazards are subject to considerable error.

Meteorological data, upon which climatic evaluations are made, have been gathered in Montana for many decades, but these observations have been made almost exclusively in valleys, near centers of population. Few data have been gathered in the mountains. Some climatic maps have been made which contour the data (temperature, precipitation, etc.) reported from these lowland stations, but ignore the areas occupied by mountains. These maps are therefore useful only for the valleys and not the entire state.

Precipitation varies with elevation in a complex way, but within Montana, higher elevations usually receive more moisture. Because of rain shadows and other effects, two points at the same elevation (even in the same valley) may get different amounts of precipitation. During winter months, much of the precipitation which falls in the high mountains is too cold to cause icing, therefore a significant percentage of the total precipitation can be removed from consideration.

In summary, the relationship between amount and timing of precipitation, average temperature during periods of rain and snow, and elevation are quite complex and change from one area to another. DNRC concludes that there simply are not enough data for the Townsend-Garrison area to be able to make a generalization that higher elevations have a higher icing potential. Climatic conditions, therefore, cannot be used to make a case for or against any of the routes or for centerline determinations.

RELIABILITY CONSIDERATIONS

MPC presented testimony asserting that since Colstrip 1 and 2 came on line in 1975-76, their system has been operating at an excessively low level of reliability. They accepted this level because they originally expected the 500 kV system to be completed by 1979. In the interim a number of outages have occurred which cascaded throughout the transmission system of the western United States, interrupting service to many thousands of customers. MPC believes these outages would have been prevented or mitigated if the 500 kV lines had been completed on schedule, and that as long as they are not in service the electrical system will remain exposed to the risk of similar future occurrences.

In response to DNRC's request for specific examples, MPC submitted Exhibits 17A-17E, analyses prepared by the Operating Practices Subcommittee of the Western Systems Coordinating Council (WSCC), of five outages over the period 1979-1981. DNRC reviewed these analyses. In each case an initial equipment failure was exacerbated either by additional equipment failures or by equipment being out of service, and when the remaining transmission system became overloaded, automatic safety devices produced a cascading series of shutdowns of transmission lines and generators. This resulted in the breakup of the WSCC system into a number of islands within which varying amounts of load had to be dropped to match generation available within the island.

DNRC agrees with MPC's contention that, had the 500 kV system been on line as scheduled, some of the effects of these outages might have been mitigated. MPC's system would have been stronger and better able to hold together. However those outages originating outside the MPC system basically were due to an insufficient capacity in the overall system to ship power to the west coast under multiple contingency outages in Idaho, Utah and Montana. DNRC does not believe that completion of the 500 kV system to Garrison would have helped in these cases, since the system broke up west of Ovando and west of Anaconda. East of Garrison the line would have helped hold MPC's system together. The system will always have to bear the risk of multiple contingency outages, since to ensure against them would require an excessively expensive duplication of facilities in comparison with the level of risk and the likely costs of outages.

DNRC concludes that reliability considerations are not a major factor in assessing the costs of delay of the completion of the Townsend-Garrison segment of the 500 kV system.

ECONOMIC CONSIDERATIONS

In its Draft report DNRC discussed the cost of delaying energization of Colstrip Unit 3 in terms of the cost of replacement energy for those project owners (Portland General Electric Company (PGE), Washington Water Power Company (WWP), and Puget Sound Power and Light Company (PSPL)) showing deficits if Unit 3 is not available in January 1984, under critical water conditions. DNRC noted that with median water the Colstrip project owners as a whole show a surplus. (Only Portland General Electric remains deficit, by 18 average MW, with median water if Unit 3 is delayed.) DNRC pointed out that in addition to the costs to the deficient partners of purchasing replacement energy, there was also a loss of the value of surplus Colstrip power that could be sold to other utilities within or without the region that would then be able to avoid running more expensive oil or gas fired generation.

The major market for surplus sales is expected to be in California because it has displaceable oil-fired generation, because this is the area where excess power from the Pacific Northwest is most often marketed, and because there is sufficient capacity to transmit large amounts of power. To transfer power to California from Colstrip it is necessary to carry it through Oregon over the North-South Intertie which consists of two 500 kV alternating current lines and one 800 kV direct current line. (BPA owns the portion of the Intertie north of the California-Oregon border with the remainder owned by California utilities, mainly Pacific Gas and Electric Company). The capacity of the Intertie totals around 4,000 MW. Since there are times when the lines are loaded to capacity, and since there are other times when market conditions may make it unprofitable to run Colstrip Unit 3 to serve California markets, DNRC has attempted to assess the value of the potential surplus sales.

In its draft report DNRC estimated the cost to the participants of meeting their critical water deficits through the purchase of oil or gas fired generation, to be in the range of \$9.6 to \$12.8 million per month if Colstrip Unit 3 is unavailable. Since only PGE, PSPL and WWP would be in deficit with critical water in the region, there would be some surplus available for sale either to deficient utilities or to utilities with displaceable oil fired generation. With critical water in the region it is very likely that a good market would exist for this power in California. With better water conditions the deficiencies of the partners would shrink and the surplus available from Unit 3 would grow, but so would the cheaper federal hydro generated power with which it competes.

There are four areas of uncertainty which affect the expected value of surplus energy from Colstrip Unit 3 for displacing oil-fired generation.

The first question concerns the amount of time the North-South intertie would be loaded with surplus hydro sales and there would be neither a market for Unit 3 power nor the capacity on the North-South intertie to transport it. BPA provided information on periods of full loading on the North-South Intertie for the past 8 years. These are presented in Table 4.

TABLE 4

Periods of Capacity Loadings on the North-South Intertie

1974	April - July
1975	May - July
1976	January - October(a)
1977	_______________(b)
1978	January, June(c)
1979	May
1980	May, June
1981	February, May - August(d)
1982	January - April

(a) Low water year

(b) Less than 1000 MW capacity left in June

(c) Low water year; only in spring runoff was intertie loaded to capacity

(d) In March and April there was less than 1000 MW capacity left

Source: Frick 1982a.

As indicated by the table, even in some years with very low water such as 1979, the tie line is fully loaded during spring runoff. Only in a very good water year such as 1976 or 1981 is the line loaded to capacity for much of the year. Therefore capacity would be available to transmit Colstrip power south most of the time that there would be a favorable market for it in California.

A second question is the amount of displaceable energy in California. There is around 8-10,000 average MW of oil and gas fired energy in California, of which around 25% is oil and 75% is gas (Meek 1982). Not all the gas fired energy is displaceable, as there is no gas storage in California and when direct gas demand is below quantities available from the pipelines the surplus is put into electric generation. Also, Pacific Gas and Electric Company has gas contracts with Canada which require the company to take the gas as scheduled or pay for it even if it is not needed. Nevertheless, since the amount of oil and gas actually displaced by Pacific Northwest hydropower is around 3100 MW in a good water year, there is plenty of remaining capacity that could be displaced.

A third question is that of price. Excess power from Colstrip will compete for California markets with other thermal power generated in the Northwest such as from the Centralia and Trojan plants and the Jim Bridger plant in Wyoming, as well as with BPA surplus hydro. California utilities appear willing to pay up to 40 or 45 mills per kilowatt-hour (kWh) if cheaper power (i.e., hydro generation above that available with critical water) is not available (Meek 1982); they will not pay their full avoided costs which are in the range of 60-80 mills per kWh. When little or no surplus hydro is available from the Northwest the price will be around 40 mills per kWh. If significant quantities of hydro are available, the price will drop to 15-20 mills. During good water years it may drop to 6-10 mills. Prices are quoted at the Oregon border. This is significant because the charges for wheeling Colstrip power to the Oregon border are around 8-10 mills (Frick 1982a). If the border price is 15 mills, the net to Montana would be 5-7 mills, which would not cover even the incremental coal costs required to generate Colstrip power. MPC places these costs at 7.14 mills. Even at a 20 mill border price, the 10-12 mill net to Montana (after wheeling costs are subtracted) might not cover variable operating and maintenance costs and fuel costs sufficiently to justify operation of Colstrip 3. In summary, even though capacity may be available on the North-South intertie around 72% of the time (7 year average), market conditions may not justify operation of Colstrip 3.

A final question is the value of displaceable oil-fired generation. MPC estimated a cost of 85 mills/kWh for oil fired generation in plants with 1200 Btu/kWh heat rate. The California Energy Commission indicates that the high heat rate and high cost plants are the first to be displaced (Smith 1982). For example, currently there exist plants with 75 mill/kWh fuel costs, with heat rates around 9800 Btu/kWh. However, a combination of air quality requirements that very low sulfer fuel be burned, together with a tight market in California for all required petroleum products, means that California utilities are currently paying $45 a barrel for fuel. (MPC projected $42.70 a barrel for 1984). MPC's estimated displacement fuel cost might therefore be too low. In the absence of an independent forecast of 1984 California prices for low sulfer fuel oil, DNRC tentatively accepts MPC's estimate of 85 mills/kWh displacement, less 7 mills/kWh for coal at Colstrip, for a net saving of 78 mills. However, line losses mean there is not a one for one displacement. DNRC does not have an exact estimate of line losses between Colstrip and California. The California Energy Commission indicates losses of 6-7 percent between the Oregon border and southern California (Smith 1982). DNRC believes 12 percent is a conservative figure to use for total losses over the full transmission path. This means one kWh generated at Colstrip displaces .88 kWh in California, or 74.80 mills of fuel (.88 x 85 mills). Subtracting 7.14 mills for the incremental coal cost at Colstrip yields a net displacement saving of 67.66 mills/kWh.

With critical water in the 1983-84 operating year, the displacement savings, which would be lost if Colstrip 3 is delayed, would be $6.1 million per month, (123 Average MW (MPC has 1 MW surplus and PPL has 122 MW surplus with critical water) x 730 hrs x .06766 = $6.1 million per month). This should be added to DNRC's earlier estimate of $9.6-$12.8 million for replacement costs under critical water for a total of $15.7 - $18.9 million per month projected costs of delay.

Under median water there are no replacement costs and the full surplus can be marketed if the price is high enough to warrant operation of Colstrip. The median water adder for the federal system is 3000 MW. DNRC believes that with median water there is a fairly significant probability that prices will be at the lower end of the 20-45 mill range, and that operation of Colstrip 3 would be uneconomical. With greater water availability, this price would drop even further. If one assumes rather arbitratily that prices under median water would justify operation of Colstrip Unit 3 an average of 8 months a year, the value of surplus sales would be $6.9 million per month (210 Average MW x 730 hours x $.06766 x 67% = $6.9 million/month). If the surplus could be marketed 100 percent of the time, the value would be $10.4 million/month. This would be an upper bound.

In conclusion, DNRC believes that critical water over-estimates the cost of delay. With median water the lost displacement savings are somewhere below $10.4 million per month; DNRC believes $6.9 million to be a reasonable guess. With critical water the total monthly delay cost would be between $15.7 million and $18.9 million. With water conditions better than median, the cost of delay would drop to zero.

COMPARATIVE COSTS OF ALTERNATIVE ROUTES

BPA supplied DNRC with Exhibit 31N, "Updated Cost Estimates" listing the construction costs of the alternative routes for the transmission line. BPA subsequently updated this information and reported that the average cost of construction for the Townsend-Garrison line is $688,000 per mile (Eddy 1982b), making the estimated cost for the BPA Final Route $63.2 million. This includes overhead costs which BPA has estimated at $55,000 per mile. The per-mile construction cost is a weighted average of $566,000 per mile in flat terrain, $670,000 per mile in rolling terrain, and $694,000 per mile in terrain which is 50% rolling and 50% mountainous. BPA indicates that the BPA Final Route is composed of 15% flat, 65% rolling, and 20% mixed rolling and mountainous terrain. These weights yield a composite cost of $659,000 per mile; the difference between the $688,000 figure and $659,000 is due to a closer engineering examination of access road requirements.

BPA has revised its construction cost estimates for the Original Boulder-Deer Lodge Route to $53.8 million.

The estimate presented by BPA in Exhibit 31N for the Helena Route, $55.1 million, is based on an earlier composite figure of $694,000 per mile. The last engineering estimate prepared on the route was made in September 1978, for the Blossburg-Garrison segment only. At that time it was assumed that MPC would build the Townsend-Blossburg segment, so MPC construction guidelines and costs were used for that segment. BPA did not feel it was possible at this time to go back and reestimate the costs for the full Townsend-Blossburg segment in a manner which would make the costs comparable to the estimates for the other segments. Therefore DNRC examined topographic maps and allocated the various portions of the Townsend-Blossburg segment of the route into the three terrain types for which BPA provided cost data; this resulted in estimates that this segment consists of 68% flat, 10% rolling, and 22% mixed rolling and mountainous terrain. The resulting composite cost estimate is $603,000 per mile for the 58.8 mile Townsend-Blossburg segment, or $35.5 million. When this is added to BPA's earlier estimate for the Blossburg-Garrison segment, the construction cost of the Helena Route is $49.8 million.

The revised cost estimates for the three routes are shown in Table 5.

Table 5
Construction Costs of Townsend-Garrison Alternative Routes

ROUTE	MILEAGE	DIRECT COST	OVERHEAD	TOTAL CONSTRUCTION COST
Original Boulder-Deer Lodge Route	83.6 mi.	$53.8 million	$4.6 million	$58.4 million
BPA Final Route	91.8 mi.	63.2	5.1	68.3
Helena Route				
A. Blossburg-Garrison	20.6 mi.	14.3	1.1	15.4
B. Townsend-Blossburg	58.8	35.5	3.2	38.7
Total for Helena Route	79.4 mi.	$49.8 million	$4.3 million	$54.1 million

Note: The mileage figures in this table differ from those reported in the TER and in Table 7 of this report due to more recent adjustments based on BPA's proposed location for the Garrison substation (Exhibit 31N).

Source: BPA, DNRC.

SUBSTATION CONSIDERATIONS

Considerable concern was expressed during the public hearing about the Garrison area substation, the function it serves in connecting the Colstrip transmission line to the existing system, and its relationship to route alternatives westward to the Montana border. Appendix B contains a discussion of electrical engineering terms and the functions and interrelationships of the components of electric transmission systems.

The following subsections discuss the substation proposed for the Colstrip project and alternative locations for the Garrison substation.

Engineering History of the Colstrip Transmission System

At the time that Montana Power Company and the other Colstrip project owners applied under the Utility Siting Act for a certificate to build Colstrip Units 3 and 4, they also applied for two single-circuit 500 kV transmission lines to Hot Springs, with an intermediate substation in the Billings area and one in the Helena area.

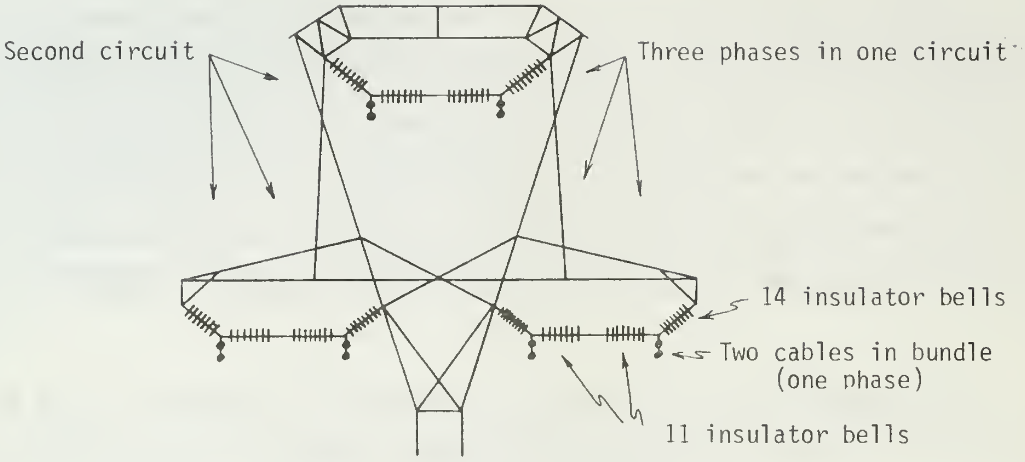
To transmit power from Colstrip Units 1 and 2, MPC built one of the lines to Broadview, which served as the "Billings-area" substation. This line was built using steel towers, insulators, and conductors which would eventually serve as one circuit of the 500 kV line but the line has been energized as a double-circuit 230 kV line since 1976. From 1976 to the present, the line has delivered power to the Broadview substation where it enters other lines in Montana Power Company's transmission network, including 230 kV lines to Great Falls and Billings.

In 1981, construction was begun on the second set of towers from Colstrip to Broadview which will carry a single-circuit 500 kV line. This construction is now underway. Also in 1981, construction began on the two single-circuit 500 kV lines from Broadview to Townsend which is still underway. After the 500 kV line now under construction from Colstrip to Broadview is energized, the double-circuit 230 kV line will be converted to a single-circuit 500 kV line as shown in Figure 5.

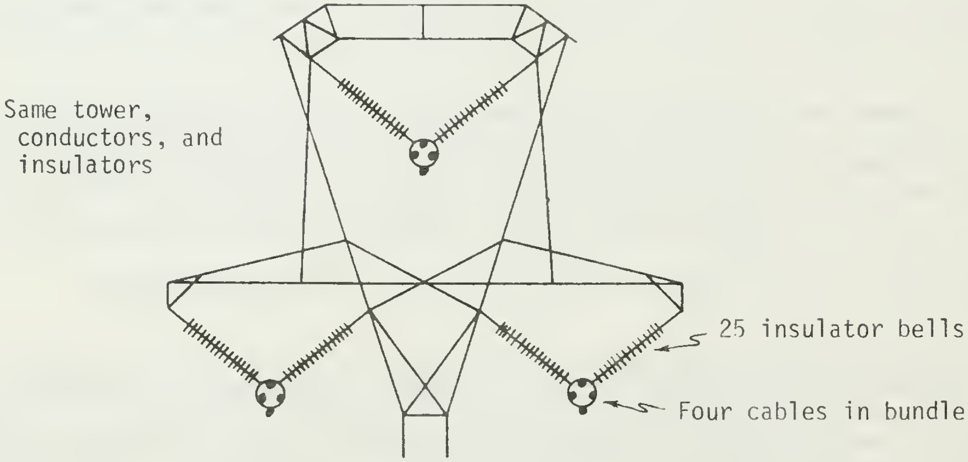
From Townsend westward BPA plans to build two 500 kV circuits on one set of towers. No substation is planned for Townsend; therefore the lines from Broadview cannot be used until they are connected to the existing transmission network at a substation (see Appendix B for further discussion). Townsend would not be a suitable place to connect the line even if a substation were built because there are no large-capacity lines to tie into as there are at Garrison and other places.

Garrison would serve as the "Helena-area" substation originally proposed by MPC when the line was to be built to Hot Springs. Two substations between Colstrip and Hot Springs (or another western Montana substation terminus) have always been an integral part of the project and are required to operate the system.

Figure 6 is a simplified schematic diagram of the completed 500 kV lines between Colstrip and Hot Springs as originally conceived by MPC. Under normal operating conditions both lines (labeled A and B) would carry the power generated at Colstrip. If an accident happens, for example on the "A" line between Billings and Helena, power could flow on both lines to Billings and from Helena but on only the "B" line between Billings and Helena. Without the intermediate substations the whole "A" line would be out of service, and over that distance, the "B" line would



DOUBLE-CIRCUIT 230 KV CONFIGURATION



SINGLE-CIRCUIT 500 KV CONFIGURATION

FIGURE 5. CONVERSION OF THE COLSTRIP TO BROADVIEW DOUBLE-CIRCUIT 230 kV LINE TO A SINGLE-CIRCUIT 500 kV LINE (after Westinghouse, 1973).

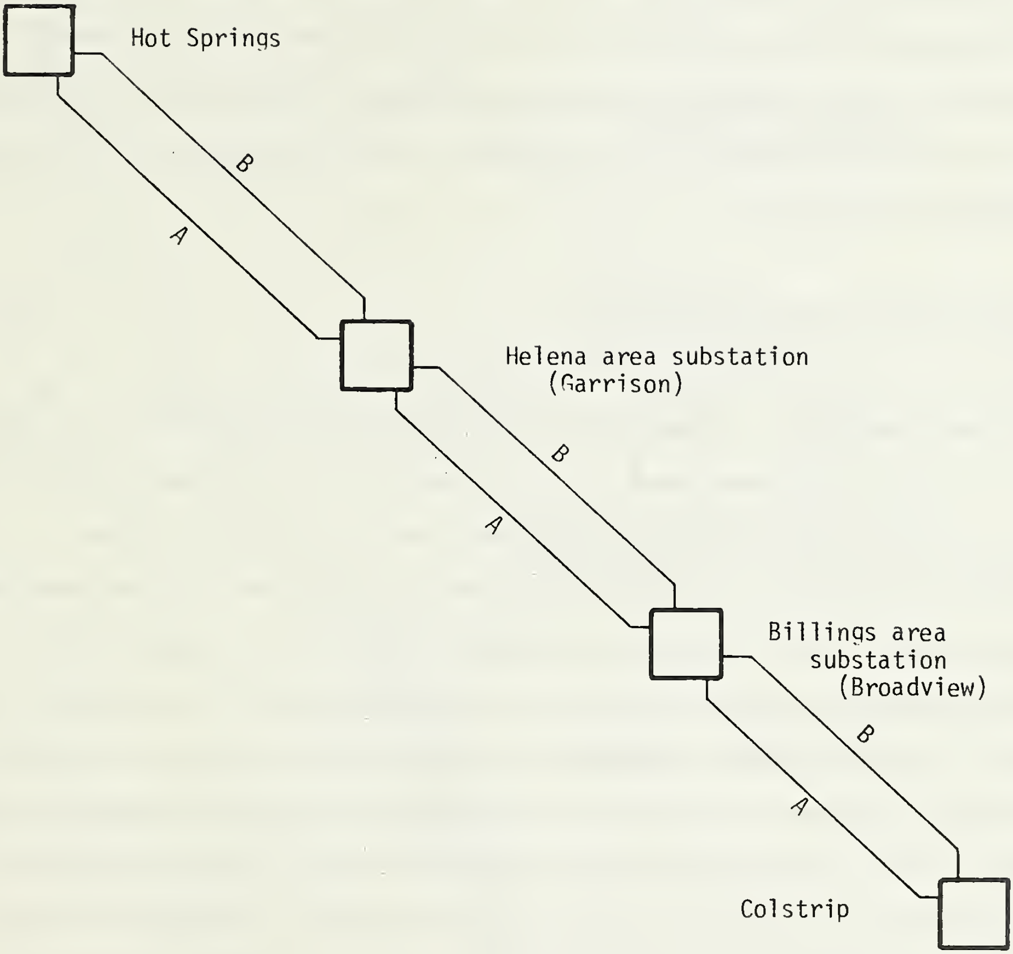


FIGURE 6. SCHEMATIC OF COLSTRIP - HOT SPRINGS 500 kV LINES WITH INTERMEDIATE SUBSTATIONS AS ORIGINALLY CONCEIVED BY MONTANA POWER COMPANY (after DNRC, 1974).

not have sufficient capacity to carry all of the Colstrip power. One line could carry the whole load over the shorter distances between substations but not over the whole distance from Colstrip to Hot Springs or whatever terminus is finally selected for the western Montana substation (see Figure B2 in Appendix B for further discussion). It is important to note that placing both lines (circuits) on a single set of towers from Townsend to the west does not alter the functioning of the lines as depicted in Figure 6.

Garrison Substation Site Alternatives

Because the Garrison substation is proposed to serve temporarily as a terminal point for the 500 kV line, other lines with sufficient total capacity must connect at the substation (see Appendix B for an explanation of the function of substations). There are two 230 kV transmission lines in the Garrison area which could be looped into the substation. Figure 7 is a schematic diagram of the proposed plan. Some length of either two double-circuit 230 kV lines (which require 120-foot high steel towers) or four single-circuit 230 kV wood pole lines (about 60-90-foot high) must be built between the substation and the existing lines (USDI 1981a, p. 4-2). Two double-circuit lines on steel towers would occupy about 200 feet of right-of-way and would cost roughly $400,000/mile to construct (Multerer 1982). Four wood-pole lines (single-circuit) would occupy about 360 feet of right-of-way and would cost roughly $360,000/mile (Multerer 1982). These figures do not include start-up costs or the cost of easements. A 360 foot right-of-way would occupy 44 acres per mile. Due to these costs, there are advantages in locating the substation site as close to the existing 230 kV lines as possible.

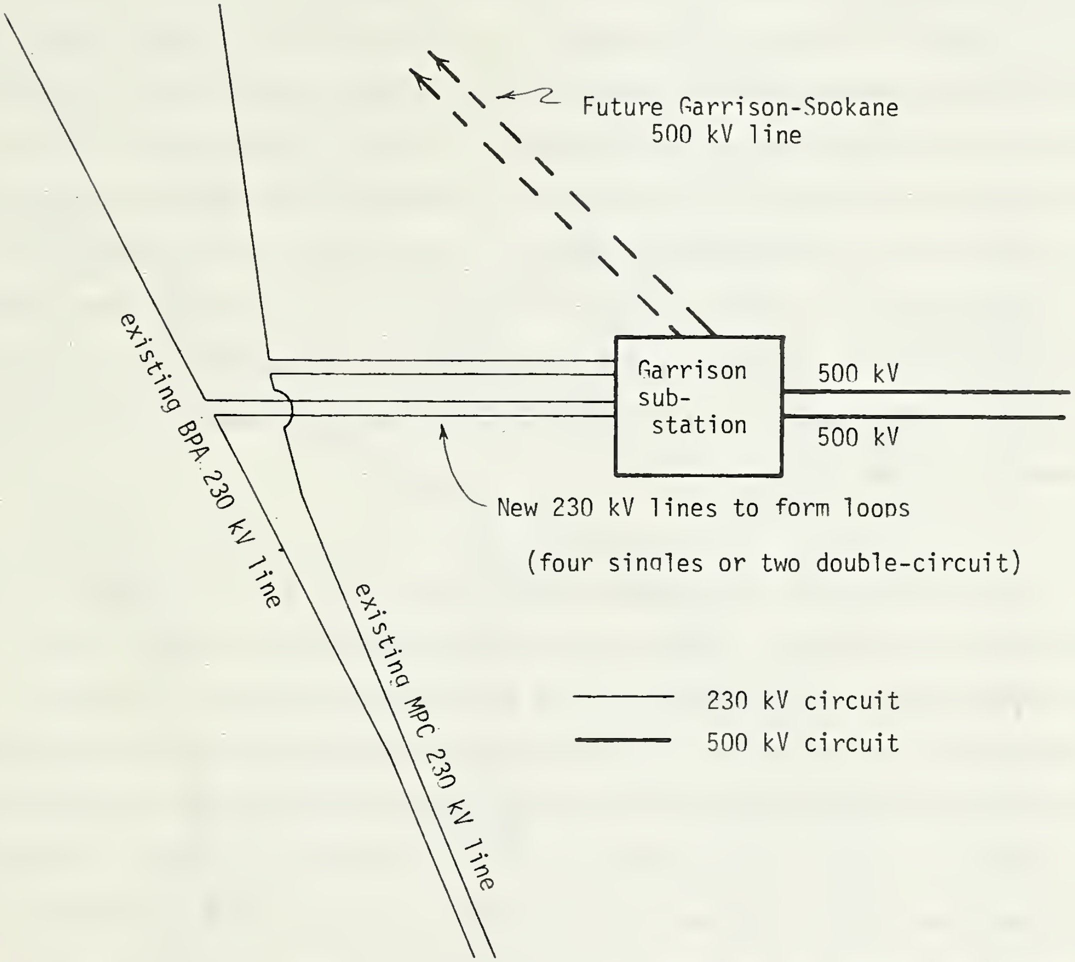


FIGURE 7. SCHEMATIC OF 230 kV LINES CONNECTING WITH GARRISON SUBSTATION.

Because transmission lines must terminate or connect at substations, the location of the substation at Garrison affects to some degree, the location of the Townsend-Garrison line and the Garrison-Spokane segment of the system and the length of the 230 kV lines that must be looped in. Although there is a great number of individual sites upon which the substation could potentially be placed, DNRC has examined four general areas which represent the range of possibilities in the Garrison area. These four areas are: 1) southwest of Deer Lodge, adjacent to the existing 230 kV lines in T7N R10W where BPA already has a vacant existing right-of-way; 2) the southeast portion of T9N R9W (east of I-90 and south of U.S. Highway 12); 3) the southwest portion of T9N R10W, where the substation is now proposed by BPA; and 4) north of I-90 and U.S. 12 on the southern flanks of the Garnet Range (see Figure 8).

Placing the substation southwest of Deer Lodge (site area 1) would necessitate crossing the Deer Lodge Valley with the double circuit 500 kV line but would eliminate significant lengths of new 230 kV line to loop into it. When the remainder of the 500 kV line is built westward from Garrison, it could parallel the existing 230 kV lines along the edge of the Flint Creek Range with a minimum amount of impact. To reach this substation site area, the 500 kV line would cross the valley about three to four miles south of Deer Lodge on one of the tentative centerlines identified in Figure 4. Impacts to irrigated land in the central part of the valley could be almost fully mitigated by centerline selection (see previous discussion of Clark Fork River Crossing). No new corridor would be opened along the east side of the valley as is presently proposed by BPA. BPA examined this alternative (USDI 1981a), but selected the present substation site (Site 3 in this discussion) due to public concerns about impacts to agricultural land, residences and visual impacts.

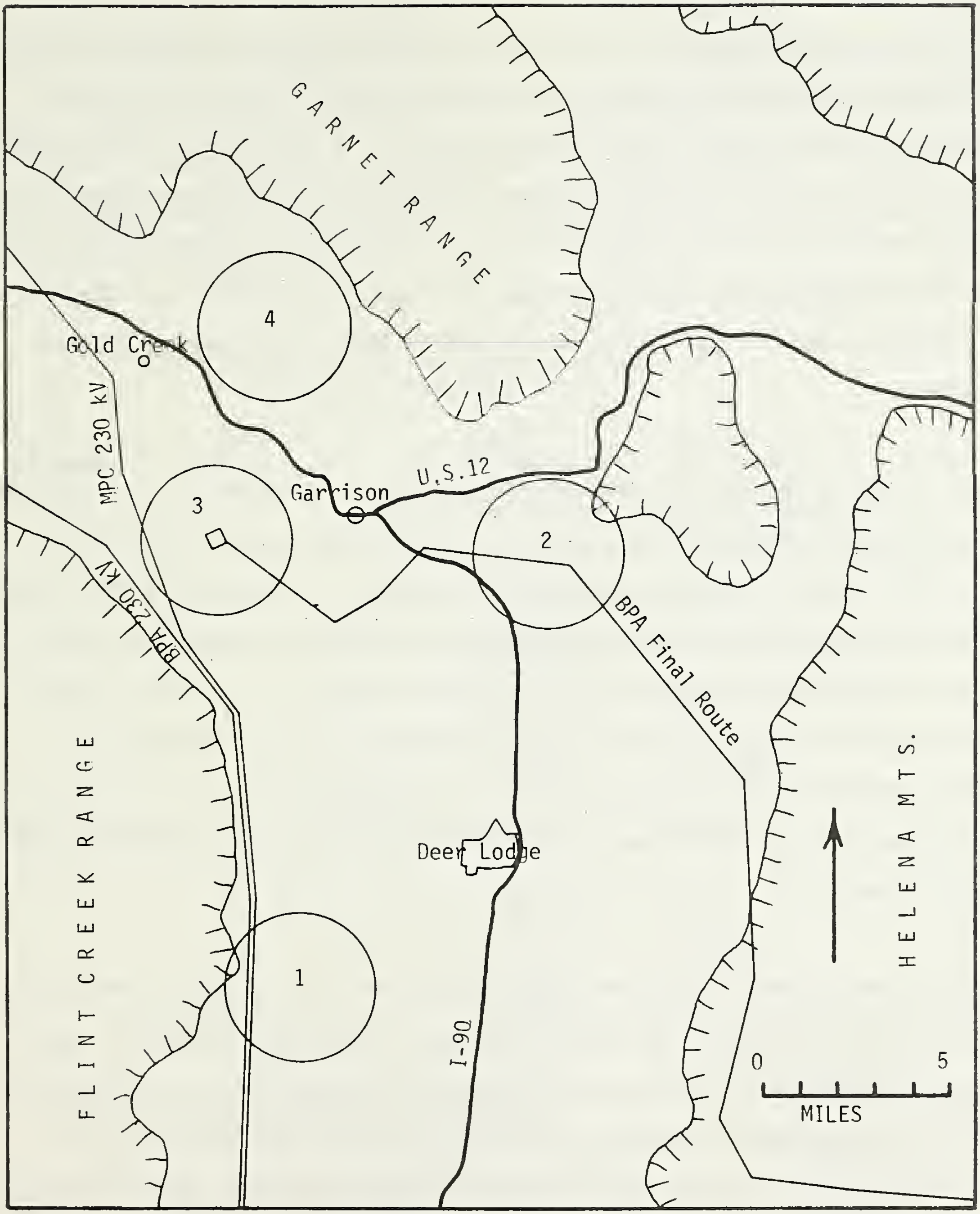


FIGURE 8. GENERAL AREAS CONSIDERED FOR SUBSTATION SITE. (Large circles only identify areas and are not meant to be boundaries of any kind. Smaller electrical lines not shown)

The second site area (east of I-90) would require crossing the valley and Clark Fork River with the 230 kV lines, and depending upon which way the 500 kV line eventually proceeds westward from the substation, it too might cross the Clark Fork River. Double circuit 230 kV lines do not differ greatly in appearance from 500 kV double circuit lines except that they are somewhat shorter -- a difference which is difficult to appreciate under some viewing conditions. This substation site area would involve opening a new north-south corridor along the east side of the Deer Lodge Valley.

The third site (the one proposed by BPA) involves a total of about 4.5 miles of double circuit 230 kV lines to connect them to the existing system (USDI 1981a, p. 4.2). BPA's site is fairly well hidden from highways and communities in the area. Access to the site is through Gold Creek, where a new bridge is being constructed and some roads are being upgraded. From this site, the 500 kV line could proceed westward toward Drummond or it could pass to the west of the Garnet Range in parallel with the existing MPC 230 kV line. Paralleling the MPC line would involve two crossings of I-90 and the Clark Fork River with the 500 kV line but not by any new 230 kV lines.

The fourth substation site area (north of I-90 and U.S. 12) would cause the 500 kV line to cross either U.S. 12 once or I-90 twice, (depending upon which side of the Deer Lodge Valley it traversed), in addition to the crossing of I-90 by two circuits of 230 kV line (assuming the MPC 230 kV line could be looped in from a point north of I-90). If the 500 kV line then proceeded westward toward the south side of Missoula, it would have to cross I-90 again, as well as the Clark Fork River.

Table 6 shows the minimum number of road and river crossings for the four areas in which the substation could be located. The two areas west of I-90 (site areas 1 and 3) would involve the fewest crossings and the least construction of new 230 kV lines. Either site also permits flexibility in choosing the route to be taken from the substation to the west.

Table 6
Road and River Crossings Associated with
Alternative Substation Sites

Westward Extension of 500 kV Lines	Substation Site Area	Number of Crossings of I-90 and Clark Fork River[1]	Number of Crossings of U.S. 12 and Little Blackfoot River
South of Missoula	1	1 500 kV	None
" " "	2	1 500 kV 2 230 kV	None
" " "	3	1 500 kV	None
" " "	4	1 500 kV 1 230 kV	1 500 kV
North of Missoula	1	2 500 kV	None
" " "	2	2 500 kV 2 230 kV	None
	or	2 230 kV	1 500 kV
" " "	3	2 500 kV	None
" " "	4	1 230 kV	1 500 kV

[1] All lines in this table are double-circuit.

Costs of Selecting a New Substation Site

Selection of a new substation site in the vicinity of Garrison would cause a delay in construction and add to the monetary cost of the project. A substation in some of the alternative site areas would also increase environmental impacts due to new 230 kV construction. A new engineering design for the substation might be required and changes would be required in construction of the lines into the substation. A new Record of Decision would be required. If the new site had already been considered in the federal EIS process, this would take only a few months. A completely new site might require a supplement to the federal EIS. Also, before construction could begin, new rights-of-way would have to be obtained. A new substation site would probably mean that no substation-related construction could occur during the 1982 field season. According to BPA, completion of the project would probably be delayed a year because all of the construction on the substation could not be completed in the 1983 season (Frick 1982b).

DNRC sees no compelling reason to recommend relocating BPA's proposed site near Garrison because it does not appear that this would reduce overall adverse impacts or increase flexibility in siting the line westward. The only other site which is comparable is the one southwest of Deer Lodge. BPA's proposed site creates the least visual impact and interferes very little with agricultural practices. It also provides for considerable flexibility in locating the westward extension of the 500 kV line. From the proposed substation site, the line could: 1) parallel the MPC 230 kV line toward the Blackfoot drainage and rejoin the Board's approved route to Hot Springs; 2) proceed toward Missoula north of I-90; or 3) proceed toward Drummond and Maxville south of I-90. The presently-proposed site also allows flexibility in approaching the site from Townsend. A route through Helena, one along the east side of the Deer Lodge Valley (as proposed by BPA) or one that would cross the valley south of Deer Lodge and parallel the existing BPA and MPC 230 kV lines is possible. No other site area provides as much flexibility with a smaller number of road and river crossings of 230 kV lines.

Any site east of I-90 and south of U.S. 12 (such as Beck Hill) would require crossing the Clark Fork River and I-90 with 230 kV lines and the westward extension of the 500 kV line would still cross either I-90 or U.S. 12. This would add little flexibility in siting the westward extension of the line to the north of the Garnet Range and any advantages would have to be weighed against the economic and environmental cost of the additional 230 kV lines.

A site on the southern flanks of the Garnet Range would require more crossings of I-90 and the river if a southern route is selected westward from Garrison and involves at least one crossing of I-90 with a double-circuit 230 kV line.

CORRECTIONS TO THE DRAFT REPORT

Correction

In DNRC's draft report, figures listed on page 15, Table 1 under "Helena Route" were based on an alternative route segment across MacDonald Pass from Helena westward to Garrison. The Blossburg segment should have been tabulated instead, since it follows the corridor the Board approved in 1976 for a greater distance. Tabulations for both Helena alternatives are given in Table 7 in this report. The two routes are very similar in their total impact scores, and are both intermediate between the Original Boulder-Deer Lodge Route and the BPA Final Route. The only determinants for which the Blossburg alternative ranks worse than the other three are rangeland (a minor determinant since no significant impact to rangeland is expected regardless of the route chosen) and prehistoric and historic sites (by an insignificant margin). This alternative ranks best for the fish and wildlife and surface water determinants. In comparing the Helena (Blossburg), the Original Boulder Deer Lodge and the BPA Final routes, the BPA Final Route ranks worst for 7 of the 12 determinants and is also worst in terms of total impact scores. It ranks best for only one determinant, agricultural land. The Original Boulder-Deer Lodge Route ranks best overall and is also best for 7 of the 12 determinants (including unique natural resources, where it is tied with the Helena (Blossburg) Route). It is worse than the BPA Final Route for only one determinant, agricultural land, where it is tied with the Helena (Blossburg) Route.

TABLE 7.
COMPARISON OF CORRIDOR ALTERNATIVES FROM TOWNSEND TO GARRISON[1]

	Helena Routes			
	MacDonald Pass Alternative	Blossburg Alternative	Original Boulder-Deer Lodge Route	BPA Final Route
Length (mi)	82.0	82.4	77.9	85.2
Determinants				
Total Impact Score	3095	3062	2923	3402
Total (adjusted for paralleling)	3028	2995	2869	-
Fish and wildlife	201	174	344	377
Land Suitability	340	316	312	357
Surface water	164	138	154	179
Vegetative cover	348	403	438	513
Unique Nat. Res.	39	0	0	10
Agriculture lands	56	48	48	29
Commercial forest lands	57	182	201	272
Rangeland	94	126	94	99
Recreation Res.	516	456	306	402
Prehistoric and Historic	318	319	187	224
Human population	296	253	201	216
Visual resources	657	647	638	724

[1] Source: USDI 1978, Table VI-1 (p. VI-4a); USDI 1981a, Table 2 (p. 2-16) and Table 7 (p. 3-36).

Note: The data in the table are based on the assumption that the same maps and data items were used in the FEIS Supplement as were used in the TER.

Correction

The following paragraph should be added to the bottom of page 35:

"Actually, no route is best to minimize impacts to all of the recreation data items. One route may avoid intensive-use recreation sites successfully, for example, but cross through more roadless areas used for recreation. The use of a "total" score on recreation for each route obscures these differences, making it seem as though one route is really better than the others. This cannot be determined, especially when impacts are reported in "miles," or "impacts per mile," without reference to specific recreation areas."

Correction

The paragraph at the bottom of page 38 and the top of page 39 should be deleted and replaced with the following:

"The three routes were all close in terms of the total impact scores (see Table 1) (Table 7 in this final report). Even if one accepted the use of these scores as a decision-making method, it would be difficult to say which route is preferred for reasons specified in the recreation section. A preferred route cannot be identified by DNRC."

Correction

On page 50, the draft report stated that according to BPA, construction of the line on any route other than the BPA Final Route would require a Federal Register notice and a new Record of Decision, followed by two years to re-survey and re-design the line and acquire the right of way before construction could start. Then, depending on the route, construction could take 2-3 seasons thereafter. DNRC does not consider it reasonable that the Original Boulder-Deer Lodge Route would require two years for re-design and re-surveying or a longer construction period than the two seasons required for the BPA Final Route. DNRC acknowledges that the Helena Route would require more time than the Original Boulder-Deer Lodge Route to re-design, survey, and acquire easements, but questions whether this process would take a full two years and then three construction seasons thereafter. DNRC believes these estimates are maximums which could be shortened if the Helena Route were actually selected and the sequence of activities to construct the line thoroughly analyzed and streamlined wherever possible. In particular the easement acquisition process might be streamlined if centerline selection were conducted jointly by BPA and DNRC.

Correction

The draft report, p. 52, line 7, states that the consolidated surplus power available to the Colstrip project owners if Colstrip Unit 3 is available in January 1984 as planned, with normal water, would be 736 (713+23=736) average MW. This should be corrected to 672 minus 22 or 650 average MW.

Correction

The second paragraph on page 62, beginning on line 2 should read: "Both the Original BDL and BPA Final Routes generally open up more new areas, although the Original BPA Route follows a utility corridor over most of the Deer Lodge valley. The Helena Route parallels within 1/2 mile of the Yellowstone Pipeline and railroad rights of way northwest of Townsend, follows an existing 50 kV powerline between Winston and East Helena and follows within 1/2 mile of the railroad near Austin. However, new areas would be opened up northwest of Avon, northeast of Avon and south of Helena."

Section III. RESPONSE TO PUBLIC COMMENT

Testimony was received from 34 persons at the Board's hearing. Written statements from an additional 13 persons and organizations were entered into the record and two letters of comment were received by DNRC. A list of the persons who testified orally or in writing is presented in Appendix F of this final report.

A number of legal issues and comments were raised during the Board's hearing which will be considered by the Board, with its legal counsel, in making a decision on the project.

General Project Concerns

Comment

Construction of the bridge across the Clark Fork near Gold Creek means BPA is going to follow its original plans no matter what the Board decides.

Response

BPA acknowledged during the public hearing that it is proceeding with construction of the bridge at its own risk.

Comment

In selecting a route for this line the Board must consider the likelihood of additional lines eventually being proposed along the same route and the cumulative impacts that would occur.

Response

The FEIS Supplement states that it is unlikely that another line from eastern Montana or Wyoming would be needed before the year 2000 (USDI 1981a, p. 1-8). While the need for and impacts of any lines proposed in the future would be fully evaluated, DNRC agrees that cumulative impacts must be considered.

Comment

The line is going to be carrying alternating current (a.c.), but the transmission power poles are going to be equipped to take direct current (d.c.).

Response

To enable conversion of a 500 kV a.c. line to d.c. operation, some additional ground clearance (about two feet) and special d.c. insulators must be designed into the facility. Neither the additional clearance nor the d.c. insulators will be installed in the Townsend to Garrison portion of the line; therefore it is not presently planned to be converted to d.c. operation.

The Garrison to Spokane portion of the line will be designed so that one circuit will have the additional clearance necessary for d.c. operation and d.c. insulators may be installed (on one circuit) depending on the price differential between the two types of insulators at the time of construction (Eddy 1982c).

If the d.c. convertability is ever used between Garrison and Spokane, an entirely new d.c. line would probably have to be built from the electrical generating source to Garrison. It is unknown whether such a line, if ever proposed, would follow the Colstrip to Garrison 500 kV line. BPA has stated that it is not aware of any plans for construction of additional lines to Garrison.

METHODOLOGICAL CONCERNS

Comment

Data used in comparing routes during the federal study were based on the assumption that the line would be constructed as twin single-circuit, 500 kV lines. However, BPA's present proposal calls for one double-circuit line using a much narrower right-of-way and much higher towers. This change may have affected the numerical values of those determinants which are sensitive to tower height (e.g., visual) or right-of-way width (agriculture, rangeland, forestry), and therefore could have changed the ranking of routes and elimination of alternatives.

Response

While MPC's twin 500 kV lines use a 300-foot right-of-way (USDI 1978, p. II-24), BPA would propose to construct twin 500 kV lines within a 210-foot right-of-way (Eddy, 1982a). This compares to a 125-foot ROW width proposed for BPA's double-circuit line. Calculations of data items and determinants in the TER were apparently based on a 300-foot ROW (e.g., USDI 1978, pp. VII-32, VII-38, VII-56). The change to a double-circuit line reduces right-of-way width by 58%, and presumably affects the impact values for the determinants by somewhat less than this amount, since estimates of land disturbance due to access roads (which were also included in the impact analysis) would not be changed. Three of the 13 determinants used in the TER (agricultural land, commercial forest land, and visual resources) would experience different impacts due to the reduction in right-of-way width and tower height associated with the BPA-built alternative. The analysis in the TER was based upon twin 500 kV steel lattice towers, 140 feet in height, on a 300 ft right-of-way (USDI 1978, p. VII-94). The Colstrip Project DEIS states that the overall visual impact of 180 ft tall double-circuit towers would be less than that of twin 140 ft single-circuit towers (USDI 1979a, p. 3.7-14 and 15). The Colstrip Project DEIS also discusses to some degree the implications of this change as far as impact severity, but the effects of the change on the ranking and elimination of alternatives is not discussed (USDI 1979a, pp. 3.7-14-16). It is possible that this change may have affected the final impact scores of the various alternatives.

Comment

The Environmental Protection Agency has concluded that BPA's EIS had insufficient information (Exhibit 24) on surface water due to the ranking this determinant was given.

Response

EPA appears to be disagreeing with BPA's judgement in assigning a weighting factor to the surface water determinant rather than with the basic availability of data on surface water in the EIS. DNRC concluded in its draft report that weighting schemes are subjective and modifications in them would likely alter the results. However, the matter is more complex than simply reweighting these three determinants. In order to determine the effect on the overall route comparison results, an assessment on the effects on the other determinants and re-analysis of the relative importance of all the determinants in relation to each other would be required.

NEED, COST AND SCHEDULING CONCERNS

Comment

Recent forecasts by BPA indicate load growth in the Northwest region of 1.6% per year, compared with 7% per year that was being projected at the time the Colstrip units were planned. BPA has just arranged to mothball the WPPSS #1 plant for up to five years. This indicates that Colstrip 3 probably isn't needed when they say it is.

Response

BPA was able to delay WPPSS #1 based on its evaluation of the likely regional balance of loads and resources, not simply because it came up with a low demand forecast. Since Colstrip 3 is part of the projected resource balance, the delay in WPPSS #1 by no means indicates that Colstrip 3 could be slipped as well. Since the region plans for critical water, it may well be that no deficits would occur if Colstrip 3 were to be delayed, if critical water does not occur. However, DNRC's estimates of the cost of delay do not rely on the regional deficit, but rather on the value of Colstrip 3 power to the project owners if they have no deficits and are able to sell the power to California utilities to displace more expensive oil and gas fired electricity there. (See Section II, Economic Considerations).

Comment

BPA indicates that critical water has never been experienced.

Response

Critical water describes a particular set of conditions which occurred during the lowest 3-1/2 years of water flow records, that of 1929-1932. BPA has been operating since 1937, and these conditions have not recurred, nor has there been a 3-1/2 year period of lower water since 1937. However, near critical conditions recur around 1 year out of 10.

Comment

The Garrison-Spokane EIS indicates that if the Colstrip transmission line is not built (i.e., the No-Action Alternative) and the power from Colstrip Units 1-4 is transmitted through the existing 230 kV system, transmission line losses of $2 million for BPA and Washington Water Power, and several times that for MPC would result. Compared with the $190 million cost of building the line, it seems more prudent not to build the line and accept the loss of a certain amount of the power through inadequate transmission capacity.

Response

The Garrison-Spokane EIS refers to the No-Action Alternative of not building the Colstrip line from Garrison to Spokane. If the Townsend-Garrision line is not built, then Colstrip Unit 3 cannot be operated at anywhere near its capacity, because the transmission system out of Colstrip and Billings does not have the spare capacity to carry it. The cost of not building is not simply the additional line losses on the existing system, but the lost value of the power.

Comment

The Public Service Commission (PSC) should be asked to supply information pertaining to rates that will be associated with this project (i.e., Colstrip Units 3 and 4) and what ratepayers are going to be affected.

Response

Montana Power Company's customer rates will go up when Units 3 and 4 enter the rate base. However, according to the PSC, the exact effect cannot be determined until that time. There are many complex factors that are involved in setting rates, and many of them, such as operating costs, are based on specific conditions which exist at the time the rates are set.

Comment

There is going to be a delay in the commercial operation of Colstrip Unit 3 due to delays in permitting the Western Energy Mine, Area C, which will furnish coal to the unit. Therefore, the Board need not feel rushed to make its decision.

Response

According to the Department of State Lands, a decision will be made on the permit for Area C by late summer, 1982. Completion of construction of the mine by the scheduled operation date of Colstrip Unit 3 (October 1983) will depend primarily on weather conditions during the 1982-83 winter season. Since it is not possible to predict these conditions, it is not possible to determine whether the mine will be delayed.

SOCIAL AND COMMUNITY CONCERNS

Comment

Since this line will be owned by a public agency, it should be located on public land. Every effort should be made to keep the line off of private land and on public land even if it means increasing costs, impacts, and length.

Response

The Board may not certify a facility unless it finds that it would have the minimum impact on the human and natural environment, considering the state of available technology and the nature and economics of the various alternatives. In making this finding, the Board must consider each of a long list of criteria, including "opportunities for using public lands for location of facilities whenever as economically practicable as the use of private land and compatible with the requirements of" the siting act. DNRC's evaluation indicated that BPA gave extensive consideration to public lands (USDI 1981a).

Comment

What types of law enforcement problems have been experienced in other locations where transmission lines have been constructed? What types are expected in Jefferson County?

Response

As noted in Section II of this report, a study of communities located near 500 kV lines in Oregon, Idaho, and Washington indicates that law enforcement problems have not been characteristic of transmission line construction projects. While Jefferson County law enforcement officials may have some calls associated with transmission line construction or construction workers, it should not put a strain on existing capacity nor require additional personnel. However, DNRC recommends that law enforcement officials be involved in pre-construction planning meetings (see Sections II and IV) to identify any unusual or potential problem areas in their jurisdiction.

Comment

Will BPA provide law enforcement impact funds to Jefferson County? If so, on what basis will they be awarded, and how will they be administered? What other types of assistance will BPA provide to Jefferson County law enforcement agencies?

Response

BPA does not expect that there will be a need to provide any impact assistance to law enforcement agencies and has no plans to provide it (Perigo 1982).

No permanent population increase results from transmission line operation, so no new long-term demand on law enforcement is expected. If vandalism or security of the line is a problem, BPA could call in the federal marshall (Perigo 1982).

Comment

The sheriff will have the responsibility of preventing recreationists from trespassing on powerline access roads and the parts of the right-of-way that cross private land.

Response

Landowners should require BPA to install gates on any access roads that they do not want others to use. DNRC is recommending an addition to its construction standards to this effect (see Section IV).

The problem of trespass exists wherever access roads cross private lands and onto public lands. The severity of the problem depends on the extent to which the roads can be gated, and where the access roads are. The Jefferson County Sheriff's office recommended that BPA meet with their personnel and the County Attorney to review maps showing the route and access roads to determine where and to what extent problems might exist. DNRC agrees that this should be done (see Sections II and IV).

Comment

During the construction phase, what arrangements have been made for emergency medical services for any construction accidents? Will a demand for service be placed on local volunteer medical service providers? What coordination has been or will be made with them? What funding is available?

Response

Normally, BPA construction inspectors are trained through advanced first aid, and the contractor keeps first aid kits on site (Perigo 1982). Construction helicopters are quite often around the work area and are available to transport an injured person if necessary. No emergency centers have been set up during the construction of other lines because severe accidents are infrequent and it has never been necessary (Perigo 1982). BPA has stated that it does not anticipate the need to provide impact aid funds (USDI 1981b, p. 6-72); however, BPA has recently proposed an impact aid formula (see Section II of this report).

Comment

Local governments will be expected to deal with fires if they occur, maintain roads and bridges, and provide law enforcement. These services must be available and since their availability is not free, how will BPA compensate local government?

Response

Fire danger from operation of the lines is relatively remote. However, during construction the contractor is required to maintain water trucks and fire fighting equipment nearby. (USDOE 1982c, Section 02.03.00B; Appendix 6, Section 13.0, and USDI 1982, Measure #61). Occasionally a fire does occur, such as from chain saw sparks. If this happens, the construction workers and equipment put it out. The largest fire Perigo recalls burned 4-5 acres under very dry conditions (Perigo 1982). In addition, BPA has an agreement with the Forest Service that its contractors will be available to help fight any fires that break out locally, whether construction of the line caused the fire or not (Perigo 1982).

BPA normally does not work with the county on county roads and bridges. That coordination is done by BPA's construction contractor, who is responsible for getting the necessary permits and for working with the county in determining whether any roads or bridges need upgrading or reinforcing (Eddy 1982d). The contractor is also responsible for establishing road maintenance agreements with the county, to repair any damage caused by construction equipment (Eddy 1982d). The costs of obtaining permits, improvements to county roads and bridges, and road maintenance are borne by the contractor as part of the contractor's bid for the job. BPA does not expend money on county roads (Eddy 1982d).

BPA does work with the Forest Service and BLM, prior to letting construction contracts, to identify needs for road and bridge upgrading, and for access road construction. The BLM and Forest Service specifications are included in BPA's Construction Specifications to its contractor. Under the Project Plan developed between BPA, BLM and FS (USDOE 1982d), road location, road standards, and road use criteria were determined jointly, and coordination on these issues is to be maintained throughout construction. BPA will finance essential documented overtime costs of the Field Representative of either agency to make certain that expeditious coordination takes place. BPA will also pay to the FS a maintenance deposit at the rate of 6 cents/ton/mile of material hauled, for use and maintenance of existing FS roads. BPA's contractor maintains all project access roads which he constructs or uses. The plan stipulates that the payments to the FS are to be made in advance, so they will be available when needed to make repairs (USDOE 1982d, pp. 7-8,28). County roads are usually of a substantially higher quality than BLM or Forest Service roads. This is one reason that BPA works with the Forest Service and BLM early on and allows the contractor to develop arrangements with the county (Eddy 1982d).

Les Sodorff, County Commission Chairman of Jefferson County stated that the County Commission sent a letter to BPA requesting a conference with BPA personnel on the use and maintenance of county roads during powerline construction and ooperation; however, BPA has not responded to their request (Sodorff 1982). BPA called Sodorff to find out which roads in the construction area were county roads, but has not responded to the request for a meeting. BPA should conduct planning activities with local governments similar to its pre-construction planning activities with the BLM and FS (see Section IV). DNRC believes this planning should be done before construction starts, to determine the likely level of expenditures the county would incur in upgrading and maintaining roads and bridges, and whether the county budget can accommodate such expenditures.

If the county bears additional costs to upgrade and maintain roads and bridges, they may be able to get reimbursed through BPA's impact aid formula (see Section II). However, this formula is not finalized yet and the earliest reimbursement date is late 1984.

Where long-term maintenance is concerned, BPA does not maintain roads or bridges that belong to the county, but it does maintain the roads and bridges required for access to the transmission towers and for maintenance of the line. Roads and bridges built for construction only are obliterated and revegetated as necessary (Perigo 1982).

Comment

Landowners must be notified directly by mail very early in the route comparison process.

Response

DNRC agrees on the importance of ensuring that the potentially affected public should be consulted and informed of project plans and routing alternatives at the front end of the evaluation. Depending on the size and length of the study corridors, identification of every conceivably affected landowner may not be practical, but well publicized scoping meetings throughout the study area and contacts with local government officials, including town and community representatives, can help ensure local awareness of the project and provide adequate and timely opportunities to make concerns known. The attitude projected by the agency or agencies involved in gathering public input is often a key factor in determining the magnitude and quality of the input received.

Comment

Since BPA has said that permanent access is not required across prime farm land, there is no reason why it should be required across other private land.

Response

While BPA does not maintain access roads where the right-of-way (ROW) crosses prime farm land, the ROW agreement allows BPA the right of access in case of an emergency. BPA's policy is to compensate landowners fully for any damage resulting from this access, including loss of crops and soil compaction. On rangeland, the access road grade is maintained but the roadway is seeded and can be grazed by livestock (Kassner 1982b). An arrangement similar to that for prime farmland, which is usually flat, could be done for other private land, unless the terrain requires maintenance of a permanent road grade to ensure that towers can be accessed.

Comment

Construction methods must minimize impacts on private land use. BPA must cooperate with landowners in road and tower locations.

Response

The location of access roads and the potential for erosion which these roads create are very important aspects of the siting process, and a number of stipulations have been formulated to reflect this concern (USDOE, 1982c, part 5, chapter 1; Appendix G, Sections 2.1,2.3, 2.4, 5.1-5.8, 11.1-11.14, USDI 1982, Measure #48 (p. VIII-6)). BPA has located the access roads and tower sites for the BPA Final route. BPA reports that the roads and tower locations were established in cooperation with affected landowners, and that an attempt was made to accommodate landowner concerns wherever possible (Kassner 1982a).

Comment

Permission for surveying and for right-of-way clearing must be obtained from affected landowners in writing, and notice of entry given on each occasion.

Response

BPA's policy is to obtain permission to survey from each landowner along the right-of-way. Clearing is generally not carried out until a ROW agreement is negotiated and the ROW agreement allows BPA access for ROW clearing and/or maintenance for the life of the line. Notice of entry is given to landowners before each phase of construction or maintenance, but is not necessarily given for each individual visit to the ROW. Where clearing must occur before the ROW negotiations are completed, access for clearing is obtained through a separate agreement with the landowner (Kassner 1982b). If these policies are observed, DNRC believes they are reasonable.

Comment

All forms of weed and brush control must be done in cooperation with area landowners and land users, and prior approval must be secured from land users on each occasion when these operations are performed.

Response

Arrangements for weed control are worked out with affected landowners by BPA (see response concerning herbicides later in this section). The ROW agreement gives BPA the right to enter the ROW for brush control or other maintenance without landowner approval, but landowners are generally notified before this work is done as a courtesy (Kassner 1982b).

Comment

Gates, cattleguards, and fences should be established in cooperation with landowners and land users and these and all other structures established in connection with construction of the line must be maintained by BPA.

Response

Roads, cattleguards and fences made necessary by the project are constructed and maintained at BPA's expense (Kassner 1982a). This concern is addressed for this project by several mitigating measures (USDOE 1982c, Part 4, Ch. 2; Appendix G, Sections 9.1-9.3,10.1; USDI 1982, Measure #57, p. VIII-11).

Comment

Helicopters should be used for tower location in areas where extensive roading would be damaging.

Response

While erection of towers by helicopter is possible (except at high elevations where thin air does not allow the heavy towers to be lifted), BPA has no plans to use helicopters for tower erection on the Townsend-Garrison segment (Kassner 1982b). Helicopters will be used, however, for sockline stringing (USDI 1982, Measure #83 p. VIII-14) DNRC has not identified any areas on the Townsend-Garrison portion of the line where the advantages of helicopter construction appear warranted.

Comment

Landowners must be adequately compensated when right-of-way easements are negotiated. Property devaluation, loss of agricultural productivity, loss of flexibility of mining operations, and aesthetic impacts are examples of factors which must be considered in determining adequate compensation.

Response

DNRC agrees. The easement negotiation process which occurs between BPA and the affected landowner is the mechanism through which the amount of compensation is determined. Landowner protection in this process is provided by Public Law 91-646, the "Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970." Title 3, Section 301(2) of this law requires that an appraisal of the property affected be made by a certified appraiser before a settlement is made, and that the landowner or an authorized representative be given the opportunity to accompany the appraiser and to point out features of the property which have a bearing on its value. The appraisal considers the value of the property in its current state and also its value after construction of the power line. The amount of compensation is based largely on the difference between these two values. The appraiser may be either a BPA staff appraiser or a private contractor. The appraiser's report is reviewed by a review appraiser (Kassner 1982c).

In making the appraisal, the appraiser must consider such impacts as property devaluation, loss of agricultural productivity, loss of flexibility of mining operations, and aesthetic impacts. In most cases, the appraisal is based on the present use and value of the land, but future uses -- such as installation of improved irrigation systems or conversion to a higher-value land use -- can be considered, provided the landowner can show that real plans for such change are being made in good faith. Possible land use changes which might be made at some unspecified time in the distant future are generally not considered (Kassner 1982c).

BPA's policy is to ensure that the landowner is "made whole" by the easement settlement (Kassner 1982c). This means that the landowner would incur no uncompensated net loss in land value or land productivity. In cases where the transmission line will conflict with a specific land use, such as sprinkler irrigation, BPA would look for ways to mitigate or offset the loss in order to restore irrigated acreage and to "make whole" the affected landowner. Measures which may be employed in such cases would include provision of substitute irrigation equipment at BPA's expense. Also, such losses as time lost over the life of the project in moving farm machinery around tower bases may be compensated in the easement settlement.

In negotiating ROW easements, a landowner may request that conditions or stipulations be attached to the agreement in order to provide specific protection. BPA is generally willing to consider such conditions, provided they are not in conflict with the intended use of the ROW for the transmission facility (Kassner 1982c). These conditions may provide for such things as installation of cattleguards, provision of substitute irrigation systems, seeding of roadways, restoration of compacted soil, planting and screening vegetation, etc. A summary of the right-of-way easement process and options, including sample forms and possible clauses which may be attached to the agreement, can be found in pages 31-50 in USDI Fish and Wildlife Service, 1979, Management of Transmission Line Rights-Of-Way for Fish and Wildlife, Volume 1.

In cases where a landowner feels that he has been inadequately compensated or unfairly treated in the easement settlement, recourse may be sought through the courts.

Comment

Adequate compensation for easements must be established on other than a one-time, per-acre payment basis.

Response

BPA's policy is that one time ROW settlements are preferred because of the additional expense involved in going through the negotiations process time after time for the entire line. Also, BPA has stated that it favors one time settlements because it believes it cannot bind Congress to providing future appropriations that would be required to make periodic settlements.

Comment

Put the lines underground where feasible and where people are impacted.

Response

As part of its recently published draft EIS on the Garrison-Spokane portion of the Colstrip transmission line, BPA reviewed underground transmission technology (USDOE 1982a, Appendix E). A discussion of this material is presented in the portion of Section II of this report concerning the Missouri River Crossing. DNRC has not identified any locations where underground construction appears warranted at this time, considering the cost and time required to obtain appropriate materials, and engineer and construct a portion of the line underground.

ECONOMIC CONCERNS

Comment

What effect will BPA's right-of-way have on payments made by the Forest Service to counties based on receipts from timber harvested in the counties?

Response

The payments the Forest Service makes to local government in lieu of taxes will continue on the Forest System lands crossed by the transmission line. Counties, however, receive 25 cents for every dollar of timber receipts the Forest Service receives from timber harvested in that county. The county will receive these payments on the timber harvested to clear the transmission line right-of-way. Since there will be no future harvests in the right-of-way, the counties will not receive payments from the area transversed by the right-of-way. It is estimated by the BPA that the BPA Final route would take approximately 400 acres of commercial timberland out of production (Eddy 1982e). Since the lost commercial timberland acreage is small, the annual growth rate of timber in the Townsend-Garrison area is slow (less than 85 cubic ft/acre/year), and the timber would not reach maturity for more than 50 years, it is doubtful that the foregone county revenues will represent any significant financial loss to the counties.

Comment

The line will have adverse impacts on mining which have not been adequately treated in BPA's environmental analysis.

Response

Much of the Townsend-Garrison route crosses mineralized terrane, a fact which is evidenced by the old mines and prospecting pits in the area. Most of the mining has ceased but some small-scale mining continues and is planned. Undoubtedly there are economic deposits which remain unmined for a number of reasons, including that they have not yet been discovered. It is possible that the 500 kV lines could interfere with future mining, but these impacts cannot be assessed until a specific ore body is identified and mining plan is advanced. BPA is currently having an evaluation of mining properties done along the Townsend to Garrison route (Frick 1982d). Unless the line would actually cross an open pit or shaft entrance area, there are few major impacts or restrictions on mining activities that would result.

Comment

Local tax bases will drop as property along the line is devalued.

Response

Nearly all private land that would be crossed by the line is classified as agricultural for tax purposes. Agricultural land is valued on productivity rather than market value. Significant decreases in productivity must result in order to lower the value of this agricultural land. Significant decreases in tax value are only likely if irrigated land can no longer be irrigated because of the line.

However, the value of residential land is based on market value. If a major transmission line is located on or within clear view of residential property, individuals may go to their county appraiser and claim their property values should be reduced as a result of the line. If these claims are successful, the local tax base would be correspondingly reduced and local governments would be impacted by the line.

Comment

Off-site devaluation of property should be reimbursed as an environmental cost of the project.

Response

Any adverse effect on property that is not crossed by the line is considered "consequential damage;" but several federal rulings have made it clear that BPA is not allowed to compensate for damages to property that is not directly affected by the line (Kassner 1982a). Under the federal land acquisition guidelines, compensation can be made only to the property that is legally encumbered.

Comment

BPA's administrator can make payments to local governments and has virtually unlimited discretion to enter into contracts.

Response

While the BPA admnistrator has discretionary authority, BPA claims that it is limited to payment for services provided on behalf of a BPA transmission facility (USDOE 1982c; Kassner 1982a). BPA has proposed a formula for providing impact aid to local governments under Section 7(m) of the Pacific Northwest Electric Power Planning and Conservation Act. The formula is discussed in Section II of this report, Social Services impacts.

HEALTH CONCERNS AND ELECTROMAGNETIC EFFECTS

Comment

The health effects of large powerlines are not known.

Response

This comment is correct in the absolute sense. However, much research has been conducted and compared to other environmental agents people are exposed to, are "remarkedly benign" (Scott-Walton 1979). (See Appendix C and the discussion in Section II on environmental effects of electrical fields.)

Comment

Low level biological effects are the subject of professional debate, and thus the line should be sited as if there is a danger, with the burden of proof on the BPA.

Response

DNRC agrees, but it must be kept in mind that scientists cannot prove that there will be no danger. (See the Section II discussion of health effects).

Comment

Camping in the summer will be dangerous because the lines will attract lightning.

Response

Lightning can strike powerlines and structures which are well grounded. Normal precautions should be taken to avoid being near tall structures during thunderstorms.

Comment

BPA says that the maximum current a person could receive by touching metal objects under the line, such as vehicles, is 5 milliamps. EPA and U.S. DOE studies indicate that the "let-go threshold" for children may be in the 3 milliamp range (Exhibit 23).

Response

DNRC agrees that the maximum current is in the range of concern for small children. To experience a current of this magnitude, a large vehicle, well insulated from the ground, must be parked under the lowest part of the span (see also Appendix C).

Comment

How can people know that their future will be secure if they suspect they are being zapped 24 hours a day with microwaves from a high voltage line? How can they be sure that their high blood pressure, frequent nosebleeds, cancer or breakdown of their immune system is not caused by incessant electromagnetic radiation, everpresent ozone, and positive-charged ions from the line running nearby?

Response

The best evidence available indicates no microwave production from the line, and that positive ions are produced only by direct current lines. Ozone is a naturally occurring gas, and is produced by the line only at levels far below standards. There is no evidence for the aforementioned health problems mentioned being caused by lines such as this.

Comment

What will be the effect on Jefferson County's emergency communication system?

Response

BPA states that FM transmissions are not affected and that any effects on other radio or TV reception or transmission systems will be resolved by BPA (see Section IV).

Comment

Under contrived conditions, fuels can be ignited under a powerline.

Response

Although no occurrences of fuel ignition have been reported, DNRC suggests that vehicles should not be refueled under the line. If a vehicle runs out of gas under the line, precautions should be taken while refueling.

Comment

In its EIS's, BPA's data presentation on health effects is misleading and biased. Quotes are taken out of context, especially when studies are summarized. When the whole study is examined, very serious implications of long-terms biological effects are indicated.

Response

DNRC agrees that BPA's presentation of data is in some cases misleading, and that the summaries misinterpret some of the data (see Section II discussion on honeybees). DNRC believes that, with respect to human health issues, the presentation in Appendix C is more balanced and complete because it points out that there is disagreement in the scientific community, outlines areas of uncertainty, and points out the trade-offs involved in reducing impacts. Nevertheless, the results are largely the same with respect to present regulatory issues. There is little indication of problems as long as people don't live under the lines.

Comment

There have been no adequate studies of health effects of powerlines.

Response

Recent findings by the Battelle Pacific Northwest Laboratories concerning possible nervous system effects in miniature swine indicate that the findings expressed in Appendix C should be updated, and the implications to Montana determined.

Comment

BPA should post a bond guaranteeing reimbursement to anyone who suffers health effects from the project.

Response

The liability of federal agencies for damages to private citizens or their property and mechanisms for compensating such damage are legally complex. The courts would probably have to determine if damages would be awarded.

Comment

BPA's bee studies weren't done in Montana and are inadequate.
Also, control hives at BPA's Lyons test facility were in poor condition, and not capable of making it through the winter. This affected the test results.

Response

DNRC agrees that BPA's discussion of effects on bees was inadequate and that there were some problems with the control hives (see SEction II). According to BPA, the Lyons test facility is located in a poor foraging area for bees. The studies are being improved, however, and are developing more precise information each year.

Comment

BPA does not pay enough attention to the importance of irritability and aggressiveness in bees caused by power lines. No line should be routed without contacting the Montana State Beekeepers Association, and individual beekeepers along the route.

Response

DNRC agrees. Bee irritability and aggressiveness is an indication that the bees are affected by a transmission line, and that honey production could also be affected (see Sections II and IV).

Comment

Additional lines can wipe out the bee industry in small, narrow valleys. Therefore the line should be sited out of valleys and on public land.

Response

In some cases such valleys cannot be avoided, and in other cases routing the line only on public land can cause severe impacts to other resources. Insufficient research studies have been conducted to determine if there is any economic impact to beekeepers who have hives substantively outside the right-of-way of a large transmission line.

ARCHAEOLOGICAL AND HISTORICAL CONCERNS

Comment

BPA failed to determine impacts of vandalism which could be caused by opening access roads through Corbin, Wickes, and Comet and has not dealt with visual impacts to the Grant Kohrs National Histcric Site.

Response

See Appendix E concerning SHPO request to BPA to address these impacts.

Comment

BPA has failed to evaluate the Red Rock Ranch for its potential historic significance, or to identify visual impacts to the property.

Response

Photographs of the Red Rock Ranch indicate that the property has the potential for being eligible for listing on the National Register of Historic Places. The property includes a blacksmith shop and equipment, the original ranch house, barn and corrals, all circa 1890, and a cabin with attached shed, circa 1900. The access road and transmission line would cross within 1000 feet of these structures. The SHPO has requested BPA to identify any impacts to sites not previously considered in its impact evaluation process, including Red Rock Ranch.

Comment

The line will seriously impact the undeveloped viewshed around the Boulder Hot Springs Hotel.

Response

BPA has not identified any visual or noise impacts to that National Register Historic property. The TER analyzed visual impacts to known historic properties up to 6 miles from the corridor (USDI 1978, p. V-14), and recommended that "historic sites,...resorts and dude ranches should be avoided whenever possible" (USDI 1978, p. VIII-16). This comment applies to the Boulder Hotsprings Hotel, which at the time of the evaluation was a resort-dude ranch. The visual analysis in the TER identifies up to 5 miles as being within the "Foreground/middleground" viewshed (UDI 1978, p. III-113). Boulder Hot Springs lies approximately 4 miles from the line, or within the "Foreground/middleground" zone. The stretch of line that would be visible from the hotel is ranked as a "high" visual impact area (USDI 1978 Figure VII-14). SHPO has requested that visual impacts to this property should be re-evaluated (see Appendix E).

ECOLOGICAL CONCERNS

Comment

What types of herbicides would BPA use, what is their purpose, and what assurances do landowners have that drinking water, groundwater, and stockwater would not be contaminated by herbicides?

Response

BPA's use of herbicides in right-of-way vegetation control is described in its Final EIS on the proposed Fiscal Year 1981 program (U.S. DOE 1980, pp. II-19 to II-75). Table 4 in that report lists herbicides used by BPA, and pages IV-26 to IV-71 discuss possible environmental and health effects of these herbicides for three purposes: (1) weed and brush control, (2) prevention of stump resprouting, and (3) sterilization of substation areas. No aerial or broadcase spraying of herbicides for general right-of-way vegetation management is proposed (Frick 1982c).

By far the most commonly-used herbicide by BPA in Montana is Tordon 101, which contains about one-half pound of picloram and 2 pounds of 2,4-D per gallon, and which effects broad-leafed plants but not grasses. Applications listed in the Final FY '81 program EIS range as high as 2 pounds picloram and 6 pounds 2,4-D per acre (USDOE 1980). This herbicide is used primarily for control of weeds and brush on access roads, but would probably not be necessary on access roads in the Townsend-Garrison area. BPA generally contracts with the county weed control boards for control of weeds on private land; the choice of herbicides is left to the county in such cases (Tyree 1982). Pramitol 5 PS is the soil sterilant commonly used at substation sites in Montana; application of up to 1960 lbs/site are reported in the FY'82 Environmental Assessment (USDOE 1981). Telvar (a soil sterilant), Chumate XNI, and Banvel 4WS are used in relatively small amounts for local vegetation control and treatment of stumps (Tyree 1982). BPA may not apply these herbicides within 100 ft of flowing streams (Tyree 1982).

Comment

Restrict BPA's use of herbicides completely and require BPA to contract out brush clearing. This is important to keep herbicides out of drinking water.

Response

DNRC feels that complete restriction of herbicide use is unreasonable, since some landowners may wish BPA to control weeds on the ROW using herbicides. However, DNRC has recommended that herbicide use be restricted (see Section IV).

Comment

If BPA uses chemicals, where will they dispose of their containers and waste materials.

Response

This issue has been addressed by the Department of Health and Environmental Sciences. BPA will use state-approved landfills for disposal of domestic and construction waste. Emptied chemical containers must be triple rinsed before disposal at approved sites. All hazardous waste materials will be transported to designated hazardous waste management facilities for treatment or disposal.

Comment

What is the matter with constructing on steep terrain? It is least productive for cattle, and elk, usually has no people near it, and the short-term construction costs are far outweighed by the long-term land use costs of siting the line in more productive, populated places.

Response

Steepness of terrain is not necessarily correlated with low productivity of forage for cattle or elk or with low human population density. One of the principal drawbacks of construction in steep terrain is the greatly increased length of access roads required. Clearing and grading of access roads in steep terrain generally results in more land disturbance than construction through flat terrain due to the land area required for cut and fill slopes adjacent to the road grade. Erosion hazard is usually greater on steeper terrain, and this together with the increased area of land disturbed increases the risk of stream sedimentation and mass movement.

Comment

BPA should have considered the riparian elk herd in the Missouri River crossing area, which consists of approximately 100 animals who have been there for about 8 or 10 years.

Response

While elk from the Elkhorn Mountains or Toston area herds occasionally pass through the dense cottonwood bottoms and islands near the Missouri River crossing, there are no resident herds in this area. In 1981, approximately 25 elk were seen in the vicinity but none are known to exist there today (Stanfill 1982; DeSimone 1982).

Comment

BPA should have mentioned specific elk herds which would be affected by the line.

Response

The BPA Final Route would affect the following designated critical areas for elk: winter range in the Keating Gulch-Johnny Gulch area (about 30 animals), the Hunting Gulch-Devil's Fence winter range (about 10-15 animals), the Wood Gulch area (about 12 animals), the Half Moon Park summer habitat, the Rawhide Creek winter range (about 12 animals), the Berkin Flats winter range, Thunderbolt Mountain summer habitat, and winter ranges on the west side of the Deer Lodge Valley (about 345 animals) (DeSimone 1982; Feist 1982; Nielson 1982). This route would open a new corridor along the east side of the Clark Fork Valley. The Original Boulder-Deer Lodge Route would be similar, except that elk winter range on the west side of the Deer Lodge Valley (about 390 animals) would be affected instead of the east side herd, less key summer habitat in the Half Moon Park area would be affected, and less winter range in the Rawhide Creek-Prickly Pear Creek area would be affected. Along this route, a transmission corridor already exists through the part of the winter range that would be traversed on the west side of the Deer Lodge Valley. The Helena route would cross elk winter ranges near the Koppen Mine south of Winston (about 150 animals) and the Corral Creek-Spokane Creek area northwest of Winston (about 166 animals) (DeSimone 1982; Feist 1982). However, actual impacts to wintering elk in these areas are expected to be slight because of the presence of existing transportation and utility corridors, roads, and other developments.

CENTERLINE CONCERNS

Comment

BPA could still improve its route by moving the line only a short distance onto public land. Two specific areas where this could be accomplished are the Kyler Ranch and the Tomlison property.

Response

According to BPA, moving the line onto public land and the Kyler Ranch would require crossing the Elkhorn Wildlife Management Area or traversing an area of "severe physical constraints (steep terrain, large granite boulders, etc.)" on

National Forest land. An entire system of new roads would be needed that would have their own associated impacts (Frick, 1981). BPA states that the route on the Kyler Ranch does not cross irrigable farmland, is over a mile away from the nearest residences, and crosses open rangeland. It would require only a small amount of timber clearing.

According to BPA, the situation on the Tomlison property is that the short distance required to move the line onto National Forest land would involve making a sharp turn in the centerline or relocating the line several miles onto an adjacent property owner (Frick, 1982c). BPA relocated an access road to mitigate potential impacts to a natural spring on the property.

SECTION IV - ALTERNATIVE ROUTE COMPARISON, MITIGATION AND RECOMMENDATIONS

The Major Facility Siting Act and the siting rules mandate that a number of criteria and natural, cultural and human resource concerns must be considered by the Board in determining whether BPA's proposed transmission line complies with the substantive standards of the Act. The substantive standards are embodied in two levels of consideration the Board must give to the criteria and resource concerns. First, the Board must weigh all of the criteria which are relevant to alternative route comparison, and determine which route minimizes overall adverse environmental impact, considering the nature and economics of the various alternatives. Therefore, part of the discussion in this section is provided to assist the Board in identifying route comparison factors which are summarized in Table 8. Second, the Board must consider the impacts of the line on each of the resource concerns and consider options for minimizing these impacts. Some adverse impacts are likely to occur with any route that is selected, while others will occur only at specific sites or areas within specific routes. Several mechanisms, in addition to route selection, are available to ensure that compliance with the substantive standards of the Siting Act is achieved and that all types of adverse impacts are minimized. These mechanisms include centerline adjustment, mitigation, and monitoring to ensure that mitigation is achieved. Further mitigation of impacts can also be achieved by BPA by compensation.

This section is presented in two parts: (1) a discussion of the alternative routes and (2) a discussion of centerline adjustment options, mitigating measures, and monitoring proposals which DNRC is recommending to the Board. The centerline options are specific to the BPA Final Route as are some of the mitigating measures, since this is the only route for which a centerline has been identified. If the

TABLE 8

ALTERNATIVE ROUTE COMPARISON

	BPA FINAL ROUTE	ORIGINAL BOULDER-DEER LODGE ROUTE	HELENA ROUTE
Length (miles)	91.8	83.6	79.4
NOTE: These mileage figures differ from those reported in the TER (USDI 1978) and Table 7 of this report due to more recent adjustments based on BPA's proposed location for the Garrison substation (Exhibit 31N).			
Cost of Construction	$68.3 million	$58.4 million	$54.1 million
Annual operation and maintenance costs	$50,500	$46,000	$43,700
Line Losses (life of project)	$23.8 million (6.6 MW)[1]	$21.7 million (6.01 MW)[1]	$20.6 million (5.72 MW)[1]
Impacts on Existing Population and Projected Changes in Social Structure and Local Life Style	Social impacts are the same as for Original BDL route; however, local people may be more satisfied with this route. Segmentation, public service impacts and concern that the siting process should be "done over and done right" are still issues. Long-term impacts include primarily the visual impactof the lines on people's perception of scenic beauty and on affected historical sites. Uncertainties about health effects of the line are also a long-term impact concern.	Social impacts have already occurred as a part of local opposition to the line, affecting social structure and local lifestyles (see p. 18 of DNRC draft report). Local people identified this route as having more unacceptable impacts than the BPA Final Route.	The Helena route comes within 1/2 mile of more residences than either of the Boulder-Deer Lodge routes, and would cross some recently irrigated land near the Missouri River crossing. Public opposition is likely to surface again on the same issues as the other routes and because of land use changes along the route in the past few years. Long-term impacts primarily visual and concerns about health effects.
Impacts on Public Services	Impacts of construction and operation are not expected to be large on any of the alternative routes.		
Impacts on Growth Patterns and Population Dispersal	Would inhibit subdivision development on the right-of-way and probably near the line as well; relatively little land falls in this category (see residential land use).	About the same as BPA Final Route (see residential land use).	Could affect the proposed "Crossfire" subdivision near Helena (see residential land use).

	BPA FINAL ROUTE	ORIGINAL BOULDER-DEER LODGE ROUTE	HELENA ROUTE
Impacts on Historic, Archaeologic and Cultural Features	According to the TER, has intermediate impact. However the rating did not include impacts to Grey Eagle Mining Complex, Morning Glory Mine, Boulder Lime Kiln, 2 prehistoric sites and 2 homesteads, all identified during centerline study, or to the Red Rock Ranch and Boulder Hot Springs Hotel, as identified in the Board's hearing. The visual impact analysis recommended by SHPO has not been completed.	According to the TER, has the lowest impact; however, some of the sites noted for BPA Final Route would also be affected by this route.	According to the TER, this route has highest impact; however, the Helena Route impact rating scores include impacts to the Helena Historic District (within 6 miles of the corridor). Sites in the district unlikely to be affected by construction on Helena Route. No survey has been done to identify sites which were not already previously recorded elsewhere.
Impacts on Visual and Aesthetic Resources	By TER criteria, has higher visual impact than Original BDL Route; however, the public appears more satisfied because this route takes the line out of the middle of the Boulder and Deer Lodge Valleys (see "paralleling" criterion).	By TER criteria, has lowest impact (see "paralleling" criterion).	By TER criteria, has about the same impact of Original BDL Route (see "paralleling" criterion).
Existing & Potential Land Use Impacts			
Agriculture Irrigated/ Dry Cropland	Crosses about 2.5 miles of irrigated cropland and 2 miles of dry cropland.[2] Impacts to agricultural production would be small and possibly fully mitigable.	Crosses about 4 miles of irrigated cropland and 4 miles of dry cropland.[2] Impacts to agricultural production would be small and possibly fully mitigable.	Crosses about 3 miles of irrigated land and 21 miles of dry cropland, mostly in the Avon area.[2] Impacts to agricultural production would be small and possibly fully mitigable.
Forestry	Would have the greatest impact on commercial forest lands (see Table 7). About 400 acres of timber would have to be cleared.[6]	Would have an intermediate impact on commercial forest lands (see Table 7). Exact acreages cannot be calculated since a centerline has not been selected within the 2-mile wide corridor.	Would have the least impact on commercial forest lands (see Table 7). Exact acreages cannot be calculated since a centerline has not been selected within the 2-mile wide corridor.
Industry	Does not cross any known industrial areas.	Does not cross any known industrial areas.	Passes over Kaiser Cement limestone mine SE of Helena (Sections 5, 9, 10, and 15 T9NR3W) and the Koppen Mining Co. mill and tailings pond south of Winston (S13T8NR1W).

	BPA FINAL ROUTE	ORIGINAL BOULDER-DEER LODGE ROUTE	HELENA ROUTE
Residential	Crosses about 1 mile of high and about 21 miles of medium impact population areas.[3]	Crosses about 2 miles of high and 13 miles of medium impact population areas.[4]	Crosses about 22 miles of high and 11 miles of medium impact population areas.[4]
NOTE: High impact means population center crossed by or within 1 mile of the corridor or ≥50 persons/sq.mi. Medium impact is 5-49 persons/sq.mi.			
Land Ownership - Opportunities for Using Public Lands	Crosses about 46.3 miles of federal land and 9.8 miles of state land.[5] (About 61% public land)	Crosses about 35 miles of federal land[5] and about 8 miles of state land.[6] (About 51% public land)	Crosses about 22 miles of federal land and about 5 miles of state land.[6] (About 34% public land)
Impacts on Recreational Opportunities	Only generic recreation impacts were specified in the federal studies; site-specific recreation opportunities were not evaluated sufficiently to differentiate the routes or to suggest mitigation. With these caveats in mind, the TER rankings were:		
	Intermediate in recreation impact.	Lowest in recreation impact.	Highest in recreation impact.
Paralleling Existing Facilities	Follows a distribution line right-of-way south of Elkhorn for 4.3 miles; follows an abandoned telephone line right-of-way (ROW) NW of Basin for 6.5 miles.	Follows a distribution line right-of-way south of Elkhorn for 9.0 miles; follows an abandoned telephone line ROW NW of Basin for 5.5 miles; Follows utility corridor (two 230 kV lines, two 100 kV lines, including vacant BPA ROW NW of Deer Lodge) for 16 miles.	Parallels within 1/2 mile of Yellowstone Pipeline and railroad rights-of-way NW of Townsend for approximately 7 miles; follows existing 50 kV powerline between Winston and East Helena for approximately 17 miles; passes within 1/2 mile of railroad near Austin for about 3.5 miles.
Climate	Climate cannot be used to distinguish between the routes.		
Geologic Suitability	Crosses especially steep terrain near Comet.		
	Geologic impacts are dealt with mostly in centerline selection; therefore this criterion cannot be used to distinguish between the routes.		
Soils Impacts	Depends mostly on design and care taken in road building and vegetation clearing; cannot be used to distinguish the routes.		
Hydrology	Because transmission lines do not impact hydrology, per se, this criterion cannot be used to differentiate the alternative routes. Soil erosion and stream sedimentation impacts are primarily a centerline concern which can be minimized by careful construction practices and stream crossings (see Water Quality).		

	BPA FINAL ROUTE	ORIGINAL BOULDER-DEER LODGE ROUTE	HELENA ROUTE
Wildlife	Would pass within 1/4 mile of 2 active osprey nests and a great blue heron colony. Would create new access through a deer wintering area in the Devil's Fence - Dry Creek area south of the Elkhorns and elk habitat throughout the southern Elkhorn Mountains.[8] Would cross elk winter range in the Berkin Flats area[8] and east of Deer Lodge.[9]	Would have nearly the same effect as BPA Final Route. Would not create as much new access in high country adjacent to Elkhorn Wildlife Management Area as would the final route.[8] Crosses elk winter range west of Deer Lodge.[9]	Would have minimal impact on wildlife.[8,9]
Air Quality	The Department of Health and Environmental Sciences (DHES) has determined that no air quality permits would be required for any of the alternative routes. Also, the routes cannot be significantly differentiated based on air quality impacts.		
Hazardous and Solid Waste	The DHES has determined that no permits would be required for any of the alternative routes. Because the amount of waste generated would be approximately the same and the requirements for disposal would be the same for all the alternatives, this criterion cannot be used to differentiate among the routes.		
Water Quality	Crosses 21.4 miles of high, 30.2 miles of medium, and 33.6 miles of low sediment risk areas.[10]	Crosses 12.2 miles of high, 37.5 miles of medium, and 30.2 miles of low sediment risk areas.[10]	Crosses 8.0 miles of high, 32.1 miles of medium, and 42.3 miles of low sediment risk areas.[10]

[1] Source: Redding 1982. Costs are based on an estimated present value of $260,000 per mile over the life of the project.

[2] Source: USDI 1978, Table VII-13, USDI 1981a, Tables 1 and 5.

[3] Source: USDI 1978, Figure VII-8; USDI 1981a, Tables 1 and 5.

[4] Source: USDI 1978, Figure VII-8.

[5] Source: USDI 1978, Table VI-3.

[6] Source: Eddy 1982.

[7] Source: USDI 1978, Figure III-1; USDI 1979a, Figure 3.1-12; USFS.

[8] Source: USDI 1978; DeSimone 1982; Feist 1982.

[9] Source: USDI 1978; Neilson 1982.

[10] Source: USDI 1978, Table VII-3; USDI 1981a, Tables 1 and 5.

Board selects a route other than the BPA Final Route, a centerline evaluation and selection process would be required and should be conducted jointly by BPA and DNRC, in conjunction with the federal land management agencies. A number of the mitigative measures are recommended by DNRC regardless of the route the Board ultimately selects.

Alternative Route Comparison

The BPA Final Route is the longest (91.8 miles) the most expensive to construct ($68.3 million), and would be the most expensive in terms of line losses over the life of the line ($23.8 million) of the three alternatives that were examined. The Helena Route is 12.4 miles shorter, would cost an estimated $54.1 million to construct, and would result in $20.6 million in line losses, while the Original Boulder-Deer Lodge Route is between the other two routes in length, construction expense, and line loss.

Opposition to the line has been considerable in the Boulder and Deer Lodge valleys, and in response to public concerns in these areas, BPA selected the BPA Final Route in an attempt to reduce impacts to agricultural land and reduce impacts on private land and residences. The BPA Final route crosses approximately 61 percent federal (Forest System and BLM administered) and state land based on its total length, while the Original BDL Route crosses about 51 percent and the Helena Route about 34 percent public land, respectively.

According to the federal analyses, selection of the BPA Final Route increased impacts on wildlife, visual resources, forested land, rangeland, surface water, and recreation. The route reduced impacts to "high impact population areas", (defined as plus or minus 50 persons per square mile, see Table 8), but increased the miles of the route that would cross medium impact population areas (defined as 5-49 persons per square mile) as compared to the Original BDL Route.

The Helena Route would have the most impact on dry cropland, an intermediate impact on irrigated land, and would cross the most private land overall. Impacts on commercial forest land and wildlife would be less than either of the Boulder-Deer Lodge routes. The Helena route would also cross two industrial mining developments and a proposed subdivision near Helena. Opposition to the line is likely to surface on the same issues as the other routes if this route were to be selected by the Board.

Based on the total length of the routes, the Helena route offers the greatest opportunity for paralleling existing facilities by a very small margin over the Original BDL Route. The BPA Final Route is significantly worse for this criterion.

The routes cannot be significantly differentiated based on the following criteria: impacts on public services, climate, soils, geologic suitability, hydrology, air quality, hazardous and solid waste, and impacts on existing population.

Water quality impacts of the routes may be compared on a quantitative basis by considering the erosion potential of land that would be crossed. Based on the federal analyses, the Original Boulder Deer Lodge Route and Helena Routes have a roughly equivalent level of impact on streams, while the BPA Final Route has the highest impact. The primary water quality consideration posed by transmission line construction is short-term turbidity and sedimentation impacts. Many of these impacts can be mitigated by careful design and construction practices.

Summary and Recommendations

The following mitigative measures and recommendations are based on the information presented in DNRC's draft report, this final report and testimony presented during the Board's public hearing and are presented in the following three categories: 1) recommendations which apply for any route that is ultimately selected; 2) recommendations which are specific to a particular route and would therefore apply only if the Board selects that route; and 3) resolutions which DNRC believes the Board should consider recommending that BPA follow for any route.

Recommendations Applicable to All Alternative Routes

Section 75-20-301(2)(c) MCA requires the Board to find and determine that BPA's proposed facility represents the minimum adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives. This substantive standard will be met only when the following recommendations are implemented:

Construction Standards

DNRC's construction standards, which are presented in Appendix G, should be followed for the entire route selected for this project, particularly where DNRC's construction standards are more stringent than the measures BPA is committed to following by its own policies or the requirements of the U.S. Forest Service and Bureau of Land Management. DNRC recommends the following additions to its construction standards.

Recommendation #1

DNRC construction standards, sections 4.6, 9.1 - 9.3, and 10.1 deal with gates, fences, and cattleguards. DNRC recommends the addition of a new section 9.4 that states, "Reasonable requests of the landowner regarding placement of fences, gates, or cattleguards for purposes of improved access OR to prevent trespass, should be followed."

Recommendation #2

DNRC construction standards, sections 2.3, 5.1 - 5.8, 11.6, 15.2 and 15.4 deal with access and maintenance roads. DNRC recommends the following addition to section 5.1: "The locations of access roads and towers shall be established in cooperation with affected landowners, and landowner concerns accommodated wherever possible."

Recommendation #3

DNRC construction standards, Section 2, deals with planning and coordination activities. DNRC recommends the addition of a new section 2.4 that states:

At least 30 days prior to beginning construction of the line, BPA's field representative and the CONTRACTOR shall meet with local officials and service providers in each affected community to advise these persons of the temporary increase in population, when the increase is expected, and where the workers will be reporting in or stationed. Maps of the line and access roads must be available so that service providers can determine where and when any problems could arise. Service providers contacted should include local officials such as county commissioners, law enforcement officials, the sheriff, fire departments, emergency services, school officials, motel or other transient lodging operators, and a representative of the Chamber of Commerce.

If problems relating to inadequate housing, schools, or other facilities are identified, this information can be provided by the contractors to immigrant workers, advising them to locate where there are adequate facilities. Arrangements can be made for emergency or other services that might be needed during construction. If trespass problems on new access roads are foreseen as a problem, gates or other solutions can be determined. If road or bridge upgrading, maintenance, or signing for safety are identified as needs, plans can be made to meet them.

Honeybee Hive Locations

BPA research indicates that honeybees can be severely affected by electrical fields at levels that can occur under the proposed line, and indicates that bees are irritated by electrical field levels that occur near the edge of the right-of-way. The research does not clearly demonstrate a physiological mechanism or a threshold level below which effects do not occur, and thus does not indicate whether bees flying through the electrical field are affected. Where hives are located on one side of a line, and foraging areas are on the other, this potential impact would be important. The research does indicate that honey production clearly increases if hives are located away from the line.

Recommendation #4

All beekeepers along the route that is ultimately selected should be informed of the known effects of electrical fields on bees, and of the uncertainties involved, and assisted in relocating hives if necessary.

Radio and Television Interference

BPA has stated that it will resolve radio and television interference problems when they occur and has stated that these problems can be mitigated through mechanical corrections to insulators, antennas, or by installation of remote antennas. In addition repeater stations can be installed.

Recommendation #5

When radio and TV interference problems occur they should be resolved by appropriate methods, including mechanical corrections to insulators and antennas, installation of remote antennas, and installation of repeater stations.

Electrical Field Effects

BPA has proposed a right-of-way width of 125 feet. BPA restricts human activity within this area, including not allowing construction of residences. The reasons for avoiding construction of houses include noise from the lines during wet weather, induction of electrical currents in metal objects, and possible effects of electrical fields on people.

Research indicates that some low-level biological effects occur under high-voltage lines, but that the evidence cannot adequately describe impacts and risk to human health. DNRC finds that the likelihood of human health effects from the 500 kV line is low, and is extremely low or non-existent if people do not live nearby. Thus, the main issue is the determination of how close to the line people can safely live.

Two other states where high voltage lines have become a public issue used edge-of-right-of-way electrical field strengths slightly lower than at the edge of BPA's line as standards to define zones where people should not live. A New York Public Service Commission judge recommended that lines be sited such that "no person lives or works daily in an electric field greater than 1.0 kv/m" (Herrold 1979). The Minnesota Health Department recommended a range of 0.5 to 1 kV/m for the edge of the right-of-way although this was not adopted by the regulatory agency (Banks 1977). BPA has stated that its proposed 125-foot right-of-way will have approximately a 1.8 kV/m electrical field at its edge, on flat terrain. The New York recommendation was based on research summarized in Appendix C of this report. Research by Battelle Pacific Northwest Laboratories, summarized in Section II, supports the need for caution in locating residences within electrical fields. The uncertainties associated with potential low level biological effects suggest the need for a safety margin. These effects indicate that BPA's restrictions on residence construction do not adequately reflect the size of the zone of environmental impacts caused by the line.

In certain conditions, such as rainy or foggy weather during the nighttime in previously quiet areas, BPA's proposed line will likely create a significant noise impact some distance beyond the 125-foot right-of-way. The distance involved could be as much as several hundred feet. Noise problems may be caused or exacerbated by defects or imperfections in the surface of the conductor. BPA has stated that it will investigate any complaints. Some complaints may be resolved by reconductoring. In the context of explaining how it resolves such complaints, BPA also stated during the Board's hearing that it would "purchase the property adjacent to the right-of-way" (Wilkerson 1982).

Measureable voltages are induced in metal objects on or close to the right-of-way. As stated in its description of grounding criteria, BPA recognizes that these effects extend beyond its 125-foot right-of-way (BPA 1975). For example, BPA grounds all metal buildings where flammable materials are stored within 250 feet of the outside conductor. This grounding policy is an effective measure of eliminating problems in most situations, but DNRC concludes that it is further evidence that BPA's 125-foot right-of-way is too narrow.

Recommendation #6

Residences should be avoided by a margin of at least 75 feet on either side of the proposed 125 ft right-of-way to protect public health and safety.

Recommendation #7

When noise problems occur they should be resolved by reconductoring or purchase of property, as appropriate.

Herbicides

Treatment of stumps by herbicides to prevent resprouting would not be necessary for the Townsend-Garrison portion of the line since annual precipitation averages less than 25 inches over almost the entire route and vegetation regrowth is generally slow. In particular, landowners have voiced concern about herbicide use in watersheds where surface water is used for drinking water. BPA's construction guidelines presently specify that herbicides will not be used on the right-of-way without landowner approval.

Recommendation #8

Herbicide should not be used unless a Montana weed control board directs otherwise or the private landowner requests such use in writing. The Final Determination of the Department of Health and Environmental Sciences on this matter should also be incorporated in the Board's final decision.

Historic and Archaeologic Concerns

As noted in DNRC's draft report to the Board, compliance with the Historic Preservation Act would satisfy the requirements of the Siting Act. At this time BPA has not yet completed the compliance process.

Recommendation #9

The requirements of the Historic Preservation Act should be met, including adherence to the recommendations of the Advisory Council on Historic Preservation.

Site Specific Recommendations

Missouri River Crossing

Recommendation #1

If the Board selects either the BPA Final or Original Boulder-Deer Lodge routes, in order to comply with the substantive standards of the Siting Act, DNRC recommends that the Board relocate the centerline crossing of the Missouri River, following the southern crossing depicted in Figure 3 of this report as closely as possible to reduce impacts to irrigated land, wildlife, residences, recreation, and aesthetics. This recommended centerline is within the Federal corridor (see Figure 3).

Recommendation #2

DNRC further recommends that BPA should attempt to mitigate all environmental impacts to the same degree it had agreed to do at its preferred crossing (USDOE 1982c, pp. VIII-3 and IX-1) and in accordance with the recommendations of the U.S. Fish and Wildlife Service (see Appendix D). In addition, construction activities should be prohibited within one-half mile of the crossing during the period March 20 - June 15 in order to minimize impacts on the great blue heron nesting colony and other wildlife.

Resolutions

Electrical Field Effects

Resolution #1

The Board should consider recommending that BPA acquire additional easements up to 75 feet on either side of its proposed 125 ft right-of-way in residential areas or areas likely to be subdivided over the life of the line.

Impact Aid

BPA has proposed an impact aid formula which requires a local government unit to demonstrate that it has spent a minimum of $1,000 providing services for BPA's facility. If the $1,000 "threshold" test is met, all costs which the local government can document that it provided due to the facility will be reimbursed by BPA. If the local government cannot document at least $1,000 in actual costs incurred, it does not qualify for impact aid (USDOE 1982b).

Resolution #2

The Board should consider recommending that BPA reimburse local governments, should expenditures be required, from an impact aid fund which maximizes rather than minimizes the payments allowable under existing law.

REFERENCES CITED

Allen, S. 1981.
Kootenai River Hydroelectric Project, Recreation. Unpublished working paper. Department of Natural Resources and Conservation, Helena.

Anderson, L.A. 1982.
Research Scientist, Battelle Pacific Northwest Laboratories, Richland, Washington. Telephone conversation (May 27) with Paul Stolen, Department of Natural Resources and Conservation, Helena.

Banks, S.; C.M. Kanniainen, and R.D. Clark. 1977.
Public health and safety effects of high-voltage overhead transmission lines: an analysis for the Minnesota Environmental Quality Board. Minnesota Department of Health, 717 S.E. Delaware St., Minneapolis.

Burgett, M. 1982.
Associate Professor, Oregon State University, Corvalis, Oregon. Telephone conversation (May 7) with Paul Stolen, Department of Natural Resources and Conservation.

Byrom, G. 1982.
Director, Area Wide Planning Organization, Helena. Telephone conversation (May 25) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Choquette, W., Holstine, C., and Bies, M. 1981.
A Cultural Resources Overview of the Bonneville Power Administration's Proposed Garrison-Townsend 500 kV Transmission Line, Powell, Jefferson, and Broadwater Counties, Montana. Bonneville Cultural Resources Group, Eastern Washington University, Cheney, Washington.

Commonwealth Associates, Inc.
Why 765 kV? A study by Commonwealth Associates Inc., Jackson, Michigan.

Darby, D. 1982a.
Environmental Manager, Bureau of Land Management, Billings, Memorandum (May 4), regarding "Distribution of 1979 BLM-Forest Service Record of Decision on Colstrip Transmission Corridor," to Steve Brown, Legal Counsel, Board of Natural Resources and Conservation, Helena.

Darby, D. 1982b.
Environmental Manager, Bureau of Land Management, Billings. Telephone conversation (May 10) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

DeSimone, R. 1982.
Wildlife Biologist, Ecological Services Division, Department of Fish, Wildlife and Parks, Helena. Telephone conversation (May 5) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Dillman, D.A. 1978.
Mail and Telephone Surveys: The Total Design Method. John Wiley and Son. New York, New York.

Eddy, R. 1982a.
Design Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 19) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Eddy, R. 1982b.
Design Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 13) with Larry Nordell, Department of Natural Resources and Conservation, Helena.

Eddy, R. 1982c.
Design Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 25) with Lynn Brant, Department of Natural Resources and Conservation, Helena.

Eddy, R. 1982d.
Design Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 20) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Eddy, R. 1982e.
Design Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 7) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Feist, F. 1982.
Wildlife Biologist, Wildlife Division, Department of Fish, Wildlife and Parks, Helena. Telephone conversation (May 7) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Frick, J. 1981.
Engineering Manager, Bonneville Power Administration, Portland, Oregon. Letter (July 17) to Tom Coston, Regional Forester, U.S. Forest Service, Missoula.

Frick, J. 1982a.
Engineering Manager, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 7) with Larry Nordell, Department of Natural Resources and Conservation, Helena.

Frick, J. 1982b.
Engineering Manager, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 19) with Lynn Brant, Department of Natural Resources and Conservation, Helena.

Frick, J. 1982c.
Engineering Manager, Bonneville Power Administration, Portland, Oregon. Testimony (May 1) to Board of Natural Resources and Conservation hearing on Bonneville Power Administration's proposed 500 kV Transmission Line from Townsend-Garrison, Montana, Helena.

Frick, J. 1982d.
Engineering Manager, Bonneville Power Administration, Portland, Oregon. Telephone conversation (June 3) with Lynn Brant, Department of Natural Resources and Conservation, Helena.

Gano, K. 1982.
Research Scientist, Battelle Pacific Northwest Laboratories, Richland, Washington. Telephone conversation (May 7) with Paul Stolen, Department of Natural Resources and Conservation.

Greenberg, B.; Kunich, J.C.; and Bindokas, V.P. 1978.
The effects of high voltage transmission lines on honey bees. Electric Power Research Institute, Palo Alto, California.

Haas, J. 1982a.
Information Systems Manager, Bureau of Land Management, Billings. Letter (May 5) to Randall F. Moy, Bonneville Power Administration, Helena.

Haas, J. 1982b.
Information Systems Manager, Bureau of Land Management, Billings. Telephone conversations (May 12,14) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Halvorson, O. 1982.
Assistant General Counsel, Bonneville Power Administration. Letter (May 3) to Steve Brown, Legal Counsel, Board of Natural Resources and Conservation, Helena.

Henderson, J. and Scott, W. 1981.
"The Economic Impact of High Voltage Transmission Towers on Agricultural Lands." Electric Power Research Institute. Environmental Concerns in Right-of-Way Management. Proceedings of Second Symposium held October 16-18, 1979. Mississippi State University.

Herrold, J.E. 1979.
Health and safety effects of EHV electric transmission lines: A review of the literature. Office of Policy, Michigan Public Service Commission, Lansing, Michigan.

Holstein, C. 1982.
Historical Consultant, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 12) with Edrie Vinson, Department of Natural Resources and Conservation, Helena.

Kassner, O. 1982a.
Assistant Chief, Division of Land Resources, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 19) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Kassner, O. 1982b.
Assistant Chief, Division of Land Resources, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 20) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Kassner, O. 1982c.
Assistant Chief, Division of Land Resources, Bonneville Power Administration, Portland, Oregon. Telephone conversation (June 3) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Kaune, W.T. 1982.
Research Scientist, Battelle Pacific Northwest Laboratories, Richland, Washington. Telephone conversation (June 3) with Paul Stolen, Department of Natural Resources and Conservation, Helena.

Kaune, W.T. and Phillips, R.D. 1980.
"Comparison of the coupling of grounded humans, swine and rats to vertical, 60-H2 electric fields." Bioelectromagnetics. Vol. 1, p. 117-129.

Meteorology Research, Inc. 1979.
Meteorological Evaluation of the Proposed Colstrip to Hot Springs 500 kV Transmission Line. Meteorology Research, Inc., Altadena, California.

Mountain West Research, Inc. 1981.
"Transmission Line Construction Worker Profile and Community Corridor Resident Impact Survey." Final Report to Bonneville Power Administration, prepared by Mountain West Research, Inc., Billings.

Malefyt, J. 1981.
"Farms and Wires." Electric Power Research Institute. Environmental Concerns in Right-of-way Management. Proceedings of Second Symposium held October 16-18, 1979. Mississippi State University.

Masters, B. 1981.
Former Secretary, Deer Lodge Chamber of Commerce. Telephone conversations (April 8, May 19) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Meek, D. 1982.
Staff Counsel, California Energy Commission, Sacramento. Telephone conversation (May 14) with Larry Nordell, Department of Natural Resources and Conservation, Helena.

Miller, R. 1982.
Chief, Permits Branch, U.S. Army Corps of Engineers, Omaha, Nebraska. Telephone conversation (May 17) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Montana Department of Natural Resources and Conservation. 1974.
Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 and 4 500 Kilovolt Transmission Lines and Associated Facilities, Volumes 1-4, November. Energy Planning Division, Helena.

Montana Department of Natural Resources and Conservation. 1978.
Centerline Report to the Board on Montana Power Company's 500 kV Colstrip Transmission Lines, Ringling to Helena Segment, January 31. Energy Division, Helena.

Montana Power Company. 1977.
Orthophoto Mosaic of Colstrip Transmission Project. Exhibit A. Sheet 31. January 28. On file at Department of Natural Resources and Conservation, Helena.

Montgomery, J. 1981.
"Colstrip Transmission Project: 1971-1981." Working paper prepared for Environmental Analysis Branch of the Division of Transmission Engineering, Bonneville Power Administration. Portland, Oregon.

Multerer, J. 1981.
C.T. Main, Billings. Telephone conversation (May 12) with Lynn Brant, Department of Natural Resources and Conservation, Helena.

Nichals, D. 1982.
Electrical Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 25) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Nielson, L. 1982.
Fish and Wildlife Biologist, Wildlife Division, Department of Fish, Wildlife and Parks, Helena. Telephone conversation (May 14) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Nordstrom, S.; Birkem E.; and Nordenson, I. 1981.
Workers in high voltage power stations: a study of pregnancies and chromosome breaks. Institute for medical genetics, and Institute of Health and Environment, University of UMEA, Sweden. Reported in Electrical Week, February 16, 1981.

Pacini, P. 1981.
State Planner, Parks Division, Department of Fish, Wildlife and Parks, Helena. Telephone conversation (May 19) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Perigo, C. 1982.
Chief, Branch of Line Construction, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 12) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Phillips, R.D. 1981.
"Biological effects of 60-Hz electric fields on small and large animals." Paper presented at the 1981 Symposium of the US/USSR Scientific Exchange Program on Physical Factors, Kiev, USSR, May 4-8, 1981. Biology Department, Battelle Pacific Northwest Labs, Richland, Washington.

Reding, J. 1982.
Engineer, Division of Transmission Engineering, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 20) with Larry Nordell, Department of Natural Resources and Conservation, Helena.

Reiner, G. 1982.
Engineer, Bonneville Power Administration, Portland, Oregon. Personal communication (March 29 and May 27) with Paul Stolen, Department of Natural Resources and Conservation, Helena.

Rodman, B. 1982.
Realty Specialist, Bureau of Land Management, Butte. Telephone conversations (May 18, 19) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Rogers, L.E.; Warren, J.L.; K.A. Gano; N.R. Hinds; R.E. Fitzner; and R.O. Gilbert. 1980.
Environmental studies of a 1100-kV prototype transmission line: an interim report. Battelle Pacific Northwest Laboratories, Richland, Washington.

Rogers, L.E.; J,L, Warren; N.R. Hinds; K.A. Gano; R.E. Fitzner; G.F. Piepel. 1981.
Environmental studies of a 1100 kV prototype transmission line. Battelle Pacific Northwest Laboratories, Richland, Washington.

Scott-Walton, B.; K.M. Clark; B.R. Holt; D.C. Jones; S.D. Kaplan; J.S. Krebs; P. Polson; R.A. Shepherd; J.R. Young. 1979.
Potential environmental effects of 765 kV transmission lines: views before the New York State Public Service Commission, Cases 26529 and 26559, 1976-1978. DOE/EV-0056. U.S. Department of Energy, Washington, D.C.

Smith, S. 1982.
Energy Economist. California Energy Commission. Telephone conversation (May 18) with Larry Nordell, Department of Natural Resources and Conservation, Helena.

Sodoroff, L. 1982.
Chairman, Jefferson County Commission, Boulder. Telephone conversation (May 19) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Stanfill, J. 1982.
Townsend area landowner. Conversation (May 17) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Tichenor, S. 1982.
President, Townsend Chamber of Commerce, and Publisher, Townsend Star. Telephone conversation (June 1) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Tyree, B. 1982.
Right-of-Way Maintenance Specialist, Upper Columbia Area, Bonneville Power Administration, Spokane, Washington. Telephone conversations (May 14, 17) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Upton, M.A. 1982.
Secretary, Townsend Chamber of Commerce. Telephone conversation (June 1) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

U.S. Department of Energy. 1975.
Electrical Effects of Transmission Lines. Bonneville Power Administration. September 15. Portland, Oregon.

U.S. Department of Energy. 1980.
Proposed Fiscal Year 1981 Program. Final Environmental Impact Statement. Bonneville Power Administration, Portland, Oregon.

U.S. Department of Energy. 1981.
Fiscal Year 1982 Transmission Facilites Vegetation Management Program Environmental Assessment. Bonneville Power Administration, Portland, Oregon.

U.S. Department of Energy. 1982a.
Garrison-Spokane 500 kV Transmission Project, Draft Environmental Impact Statement. Bonneville Power Administration, Portland, Oregon.

U.S. Department of Energy. 1982b.
"Notice of Proposed Impact Aid Payments Formula and Opportunities for Public Review and Comment." Bonneville Power Administration, Portland, Oregon.

U.S. Department of Energy. 1982c.
Specifications for the Construction of the Broadview-Garrison No. 1 and 2 Townsend-Garrison Section Schedule II, Mile 171 to 206. Bonneville Power Administration, Portland, Oregon.

U.S. Department of Energy. 1982d.
"Project Plan for Colstrip Townsend-Garrison Double Circuit 500 kV Transmission Line on Federal Lands Administered by U.S. Department of Agriculture, Forest Service and U.S. Department of Interior, Bureau of Land Management." Bonneville Power Administration, Portland, Oregon.

U.S. Department of Interior. 1978.
Colstrip Transmission Environmental Report: Draft Interagency Colstrip Transmission Corridor Analysis. Bonneville Power Administration, Bureau of Indian Affairs, Bureau of Land Management, Forest Service, Billings.

U.S. Department of Interior. 1979a.
Colstrip Project Draft EIS., Vol. 1-3. Bureau of Land Management, Bonneville Power Administration and Forest Service, Billings.

U.S. Department of Interior. 1979b.
Record of Decision, Federal Transmission Corridor, Colstrip Project, September 21. Montana Bureau of Land Management and Region 1 Forest Service, Billings.

U.S. Department of Interior. 1981a.
Final Supplement to the Colstrip Project EIS, July 31. Montana Bureau of Land Management, Bonneville Power Administration, and Region 1 Forest Service, Billings.

U.S. Department of Interior. 1981b.
Record of Decision on the Final Supplement to the Colstrip Project EIS, August 8. Montana Bureau of Land Management, Bonneville Power Administration, Region 1 Forest Service, Billings.

U.S. Department of Interior. 1982.
Preliminary Centerline Environmenal Assessment. Colstrip Project, 500 kV Transmission Lines, Townsend to Garrison Substation. "Mitigation Report." Montana Bureau of Land Management, Region 1 Forest Service, and Bonneville Power Administration.

Varner, J. and Patel, S.
Irrigation Systems and Their Impact Upon Existing and Proposed Transmission Lines. Presented at the Third Symposium on Environmental Concerns in Rights-of-Way Management. San Diego, February, 1982.

Waldron, C. 1982.
Secretary, Chamber of Commerce, Deer Lodge. Telephone conversation (May 19) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Westinghouse Environmental Systems. 1973.
Colstrip Generation and Transmission Project. Applicant's Environmental Analysis for Certificate of Public Convenience and Necessity under Major Facility Siting Act, on file with Montana Department of Natural Resources and Conservation, Helena.

Wilkerson, R. 1982.
Manager, Upper Columbia Area, Bonneville Power Administration, Spokane, Washington. Testimony at hearing (May 1) on Bonneville construction of Townsend-Garrison segment before Board of Natural Resources and Conservation.

Wirtz, E. 1982.
Project Manager, Final Supplement to the Colstrip Project EIS, Bonneville Power Administration, Portland, Oregon. Telephone conversation (May 11) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

Wood, Major G. 1982.
Training Site Manager, Montana National Guard, Helena. Telephone conversation (May 17) with Larry Thompson, Department of Natural Resources and Conservation, Helena.

Woodgate, W. 1982.
Jefferson County Attorney, Boulder. Telephone conversation (June 3) with Nancy Owens, Department of Natural Resources and Conservation, Helena.

APPENDIX A

EXHIBITS

	Mailing List - Townsend-Garrison draft
	Letter from D. D. Davis
	Letter from Jed Stanfilll
	Memo from Dave Darby to Steve Brown
No. 11	Certificate of Service
	Affidavit of Publication from The Silver State Post of Deer Lodge
	Affidavit of Publication from the Townsend Star of Townsend
	Affidavit of Publication from The Montana Standard of Butte
	Affidavit of Publication from The Tribune of Great Falls
No. 12	Letter from Omar Halvorson to Gordon Holte
No. 13	Letter from Omar Halvorson to Dr. Drynan
No. 14	Army Corps of Engineers Permit and letter for BPA 525 kV Transmission Line
No. 15	Estimated 1985 property taxes generated by Colstrip 1-4
No. 16	Northern Plains Resource Council letter to landowners (1976)
No. 17A	Western Systems Coordinating Council Systems Disturbance Report for 0239 MST Feb. 19, 1979
No. 17B	WSCC Systems Disturbance Report for 1433 PST Nov. 27, 1979
No. 17C	WSCC Systems Disturbance Report for 0937 MAST Sept. 24, 1980
No. 17D	WSCC Systems Disturbance Report for 1718 MST Feb. 23, 1981
No. 17E	WSCC Work Group Report on Aug. 31, 1981 Disturbance
No. 17F	Summary of Colstrip 1 & 2 Generation Curtailments
No. 18	Letter from Linjanen opposing BPA
No. 19	Granite County Alliance letters opposing BPA
No. 20	Gold Creek residents' letters opposing BPA
No. 21	Letter from Ray Breuninger, DNRC to Bill Meyer, BPA, April 3, 1981
No. 22	Wally Steucke, DOI, letter to Jerry Frick, BPA
No. 23	Health & Environmental Effects of EHV (2 reports - Paul Smith)
No. 24	Letter from Alan Merson (USDOE-EPA) to Ron Wilkerson

No. 25	Robert H. Moss Property Maps
No. 26	Edith M. Overholt "Red Rock Ranch: Property Maps
No. 27	Order for Delivery of Possession - Judge Hatfield
No. 28	Letter to Robert Moss from Gronvold, BPA re: Eminent Domain
No. 29	Letter from Craig Holstine, BPA, to Marcella Sherfy, State Historic Preservation Office
No. 30	Letter from Larry Lattin opposing BPA
No. 31	Letter to Steve Brown from Omar Halvorson
No. 31A	Rationale for heavy and severe icing areas
No. 31B	Environmental Studies of 1100-kV Prototype Transmission Line - Battelle
No. 31C	BPA Analysis Sheet
No. 31D	BPA Final EIS for FY 1981 Program
No. 31E	BPA Environmental Assessment for FY 1982 - Transmission Facilities Vegetation Management Program
No. 31F	Letter from Bruce Rogers, BPA, with FONSI
No. 31G	Appendix B - TER Public Involvement
No. 31H	Appendix C - Public Involvement and Information Plan
No. 31I	Appendix D - Consultation and coordination with others
No. 31J	TER Work Management Plan
No. 31K	Determinants
No. 31L	Segment Analysis and Evaluation Matrix
No. 31M	Colstrip Draft Environmental Statement
No. 31N	Updated Cost Estimates

APPENDIX B

ENGINEERING OVERVIEW

Introduction

This appendix is intended to provide a short, non-technical review of the physical and engineering aspects of transmission systems which must be understood to be able to evaluate various engineering and environmental options for siting electrical transmission lines and associated facilities.

Electrical Terms and Concepts

The distinction between energy, power, and other physical concepts must be understood before electrical transmission can be understood.

Energy is defined as the ability to do work (in a physical sense) and occurs in many forms including light, heat, chemical (as in coal), electrical, and others. Energy cannot be created or destroyed (except in nuclear reactions) but is converted from one form to another, such as in electrical generating plants and common appliances. Electrical energy is commonly measured in kilowatt hours or similar units.

Power is the rate at which energy is delivered. A machine which accomplishes a unit of work over a long period of time has much less power than one which does the same work in a short time. The watt is the basic unit of power (a kilowatt is a thousand watts and a megawatt is a million watts). The standard measure of electrical energy, the kilowatt hour, is the energy equivalent of one kilowatt (of power) delivered for one hour.

The volt is the basic unit of electrical force and it can be thought of as similar to pressure. It is the difference in voltage across some resistance (such as the filament in a light bulb) which causes a flow of electrons through a circuit. This flow of electrons is called current, which is measured in amperes. Power is related to the voltage multiplied by the current and another way of expressing power (in alternating current circuits especially) is the volt ampere, kilovolt ampere (KVA), etc.

Alternating current (A.C.) was almost universally chosen over direct current (D.C.) by utilities many decades ago partly because A.C. can be efficiently transformed from one voltage to another. Appliances used by industrial, commercial, and domestic customers cannot accept the voltage used in transmission since the voltage must be stepped down (i.e., transformed); therefore A.C. has the advantage. Direct current is used for some transmission facilities, but it is converted back to A.C. for distribution.

To efficiently transmit power, it is desirable to keep the voltage high and the current low so that line losses (partly due to heating of the line by resistance) and consequent voltage drops are minimized. Roughly speaking, the capacity of a line increases as the square of the voltage. Doubling the voltage increases the capacity by four times. It is for this reason that transmission lines today operate at voltages as high as 765 kV, and research is being conducted for lines of over 1000 kV. One 765 kV line can carry as much power as two and a half 500 kV lines or about eleven 230 kV lines. For this high-voltage electricity to be useful, it must be transformed to lower voltages before it reaches the ultimate customer.

Alternating current transmission lines always have three (or multiples of three) sets of conductors, called phases. A single circuit has three phases. The circuit (consisting of three phases) is the working unit in transmission. Two or more circuits may be placed on a single set of towers but, electrically, these circuits function as individual lines. The described voltage of the line (say 500 kV) is that between any two phases of the circuit. (D.C. lines have only two sets of conductors.) One or two additional wires are sometimes located high over the conductors and are not insulated. These protect the line from lightning and do not carry electricity (except in lightning strikes and the like).

Electrical Systems

Electrical service is provided by a complex, interconnected system of facilities. Components of this system are spread over the nation and no part of it works independently of the rest of the system.

Electricity originates in generators which convert mechanical motion of the shaft to electrical energy. A shaft may be turned by a coal-fired or nuclear-powered steam turbine, by running water, wind, or another source of energy. Voltage at the generator is in the order of a few thousand volts, which is much too low to transmit very far. Located at each of the generation plants is one or more "step-up" transformers which increase the voltage to that required for transmission.

From the relatively few central generation plants, the electricity flows over an interconnected set of high voltage lines which constitute the transmission system (see Figure B-1). Individual lines originate and end at substations which enable power to be drawn from the system and to connect transmission lines of different voltages. Several kinds of safety and control equipment which protect the system and help maintain reliability are located at substations.

Electricity flows along the path of least resistance from generator to point of use. The amount of power passing through any one section of line at any moment depends upon which generation stations are operating and the total configuration of users. These patterns of generation and use are constantly changing; thus, the flow of power in the transmission system constantly changes.

Figure B-1 illustrates the net-like character of the transmission system, or grid. In the case shown, each substation is supplied by at least two lines. In the case of failure of any one line the system will keep each substation energized. In this hypothetical situation, the 230 kV lines form a loop and tie this portion of the system into the larger system to the east and west. As noted previously, transformers are required to enable power to flow between lines of different voltage. Transmission transformers are quite large and are located at substations. To protect the transformers and lines, and ensure public safety, the substations also contain equipment to detect overload conditions and shut off portions of the system, much like fuses and circuit breakers do in a house. The system is designed to maintain service to all customers if any line should fall

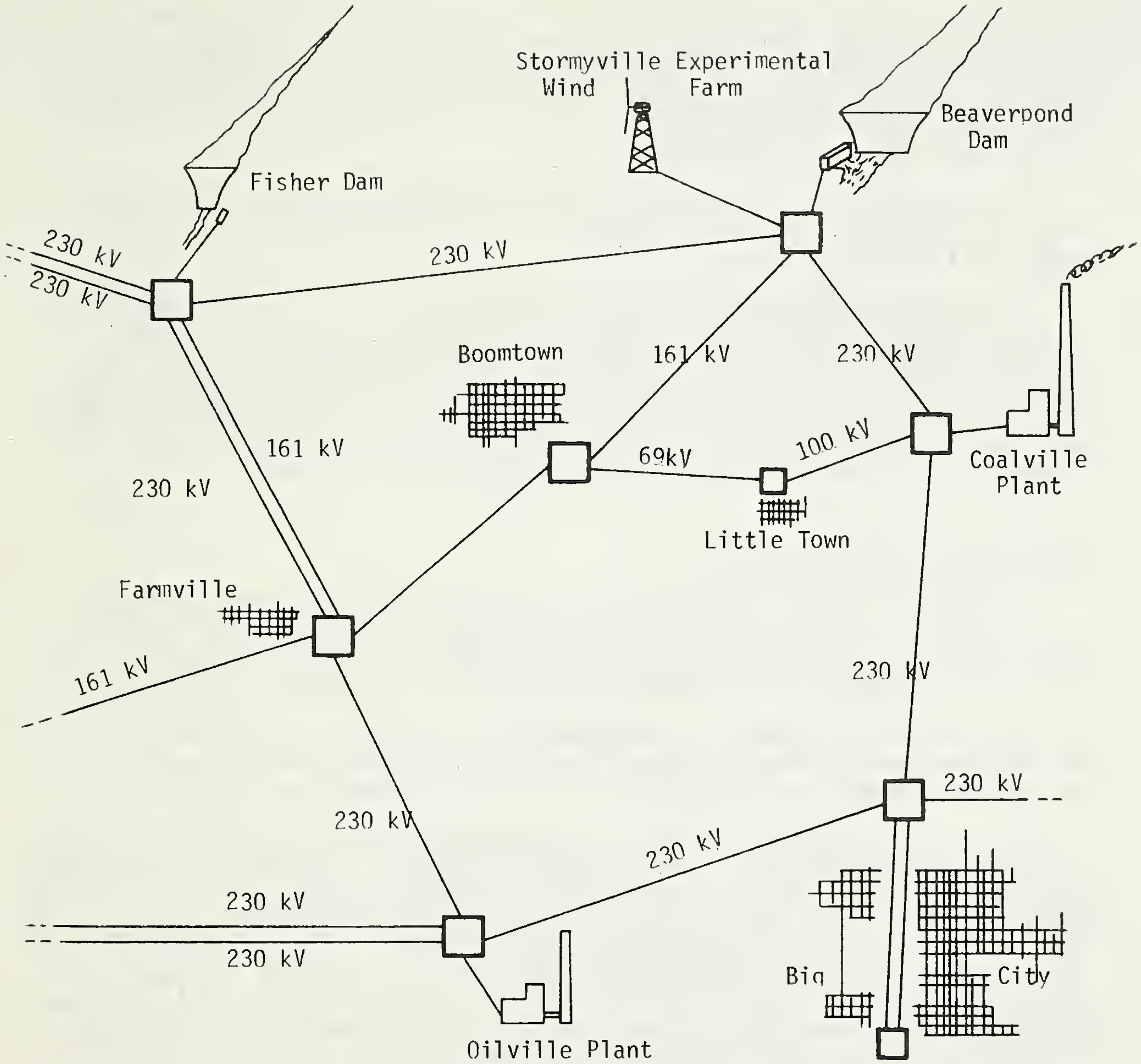


FIGURE B1. HYPOTHETICAL PORTION OF A TRANSMISSION SYSTEM (squares represent substations).

or become overloaded. Without sufficient capacity in the system, however, a loss of one line can lead to the overloading of other lines which causes the circuit breakers to isolate them. In turn, this puts more load on the remaining lines. Under certain conditions, large-scale failure of the system occurs, affecting many states in some cases. Exhibits 17A-E from the Board's hearing are analyses of five cases of system disturbance.

The capacity of a transmission line is determined in part by voltage and length, as shown in Figure B-2. Capacity is also limited by the spacing and capacity of connecting lines.

The distribution system consists of numerous lines of lower voltage (less than 69 kV) which supply the individual customers in an area. The common, single-pole power lines found in back alleys and along country roads are part of this system. Some distribution lines have three conductors (phases), but some are single phase and have only two conductors (one "hot" and one "ground"). The distribution system is energized by the transmission system at substations; however, not all transmission substations serve that function.

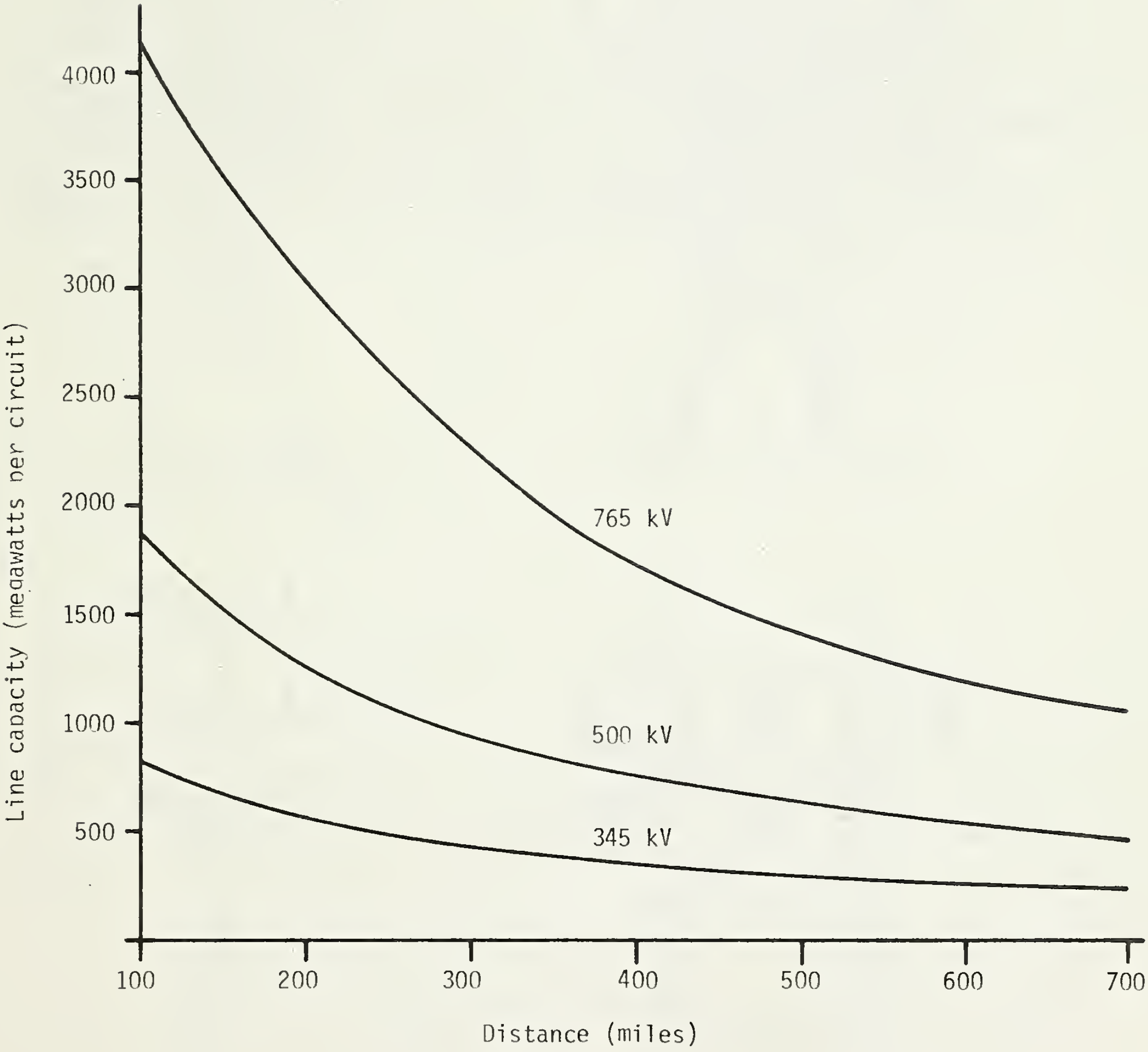
Design of Transmission Lines

Transmission lines in Montana are usually one of the following voltages: 69 kV, 100 kV, 115 kV, 161 kV, 230 kV, and 500 kV. Lines up to and including 230 kV can be built with wood poles and cross arms. All 500 kV lines and some of the lower voltage lines in Montana are constructed on steel structures.

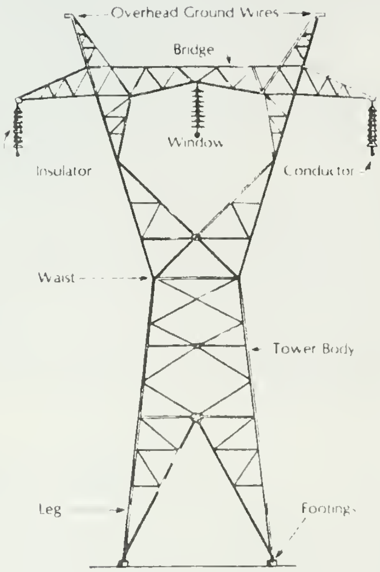
Many different designs of towers are in use throughout the United States, but the wood-pole "H" frame design is, perhaps, the most common (Figure B-3). The higher voltage lines usually require taller, stronger towers.

The electricity flows through the conductors which usually consist of cables of steel and aluminum wires. The aluminum is a better conductor of electricity and the steel adds tensile strength so that long spans are possible. Most transmission lines use strings of bell insulators from which the conductors hang. To estimate the voltage of the line, the number of bells in the insulator string can be counted and multiplied by 20 kV. For instance, a 100 kV line usually has five bells per string and a 230 kV line has about 12 bells. On lines above 230 kV, the conductors in each phase consist of two or more individual cables held apart a certain distance by spacers. This design (referred to as bundled conductors) effectively increases the diameter of the conductor, which reduces certain undesireable electrical effects.

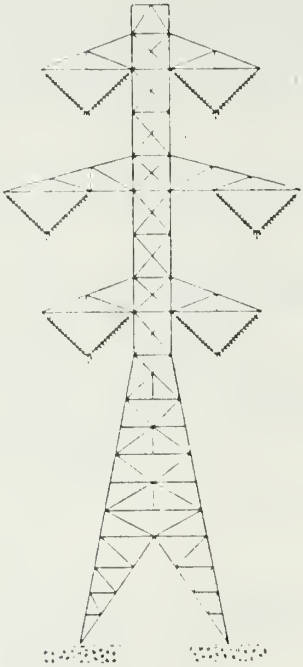
Specified distances must be maintained between conductors, and between individual conductors and the tower, ground, trees, buildings, etc. In designing a line, engineers must take into account sway of the lines due to wind and sag due to temperature changes. Some vegetation usually must be removed, especially trees which might be within these specified distances or which might fall in such a way as to cause a discharge or to damage the line. However, the old practice of removing all vegetation from one edge of the right-of-way to the other is not necessary.



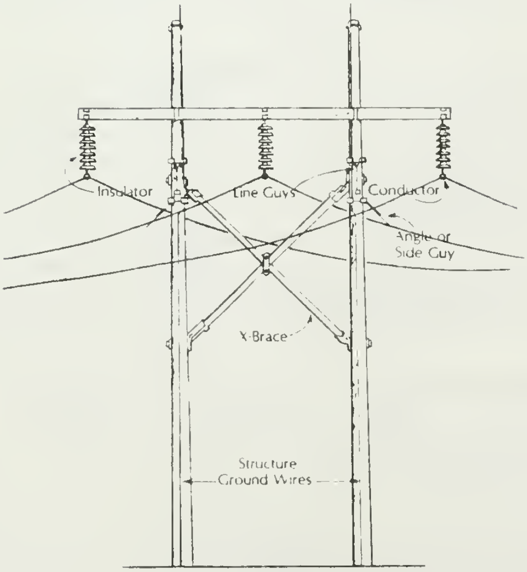
B2. COMPARISON OF CAPACITIES OF UNCOMPENSATED TRANSMISSION LINES OF DIFFERENT VOLTAGES AND DISTANCES (from a study by Commonwealth Associates Inc.).



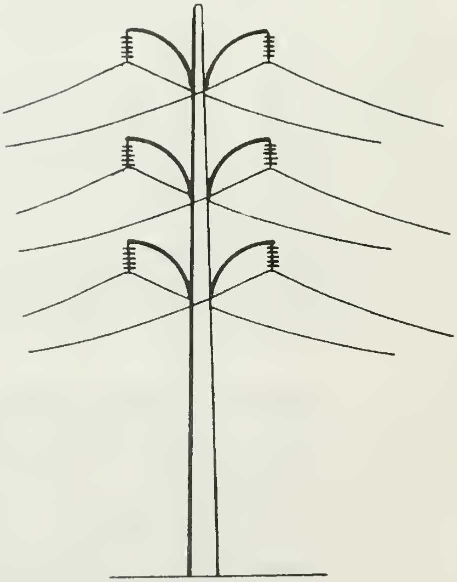
Typical steel structure



Double-circuit
steel lattice structure



Typical wooden H-frame
structure



Single-pole
double-circuit

B3. EXAMPLES OF COMMON TRANSMISSION LINE TOWER DESIGNS.

APPENDIX C

Summary of Public Health Issues of High-Voltage AC Electric Transmission Lines

This appendix contains an executive summary of an analysis of public health issues raised during hearings on a 765 kV alternating current powerline in New York. The summary is reproduced here because the information is an objective appraisal of a situation similar to that presently being considered by the Board. It should be kept in mind the electrical fields and noise levels of the 765 kV line are higher than BPA's 500 kV line, and that there has been research on these issues since the hearings were held. The analysis was done by SRI International, formerly Stanford Research Institute.

DOE/EV-0056
UC-11, 97(a), 97(b)

Potential Environmental Effects of 765-kV Transmission Lines: Views Before the New York State Public Service Commission, Cases 26529 and 26559, 1976-1978

November 1979

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Under Contract No. DE-AM-03-76SF0015
Project Agreement DE-AT03-76-EV70120

EXECUTIVE SUMMARY AND RECOMMENDATIONS

In 1973-74, Rochester Gas and Electric Company, Niagara Mohawk Power Corporation, and the Power Authority of the State of New York applied to build two 765-kV electric power transmission lines. Public concern about the first U.S. lines of such voltage—concern fueled by many articles and a widely read book by Louise B. Young, *Power Over People**—caused the New York State Public Service Commission to convene hearings on the potential health and environmental effects of operating the lines. These hearings served, in effect, as a forum for experts and concerned scientists to discuss the potential effects of very high voltage lines. Testimony, which took place from October 1975 to June 1977, focused on the following general questions:

- What are the effects on people and communities from the audible noise produced by 765-kV transmission lines during foul weather?
- Do the electromagnetic fields under the lines affect biological systems and are such effects potentially hazardous to people?
- Do people receive hazardous sparks and currents when touching a vehicle parked under a 765-kV line?
- Can the electromagnetic fields under the lines disturb cardiac pacemakers and are such effects potentially hazardous?
- Will the ozone produced during corona discharge damage plants?

Although testimony explored these questions, issues remain and some controversies are unsolved. Because the testimony on the technical issues occupied 14,000 pages and because of controversies among expert witnesses, the Department of Energy (DOE) asked SRI International to review the testimony, clarify issues raised, resolve technical questions that remained unanswered, if possible, and to recommend research to resolve data deficiencies.

Many questions raised in the hearings can be answered by credible research programs. Other issues are primarily philosophical, although decision-making bodies such as courts, Congress, or the Environmental Protection Agency (EPA) must frequently take positions on them. The SRI International Project team has not tried to resolve these philosophical questions; rather, team efforts have been exerted in examining the testimony and key exhibits to set forth and clarify these issues.

The Expert Testimony

Audible Noise

Noise from a 765-kV transmission line sounds like humming or buzzing, and is loudest during periods of high corona discharge (that is, air ionization on the surface of the conductor wires). The electric field at the surface of the conductor ionizes the air where water condenses on the conductors. The ionization process produces the noise, and at night a corona glows on the conductor surface. The experts agreed that the noise would not cause physiological damage nor cause any direct physiological effects.

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*L. B. Young, Power Over People, Oxford University Press (New York, 1973).

The noise might disturb some people within 250 m (750 ft) on either side of the right-of-way.

How much noise do the lines produce outdoors?

Noise from the lines is highest during rain, snow, and fog.

Energy equivalent noise levels over the year are about 53 dB (the levels would be higher during foul weather, but lower during fair weather) at the edge of the right-of-way (that is, 38 m, or 125 ft, from the center of the transmission line), while on peak noise days the energy equivalent day/night weighted level is 58 dB.* Transmission line noise near the right-of-way will typically be greater than noise created by the storm activity of rain and wind alone and will be more apparent during fog and snow than during rain. Transmission line noise levels decrease quickly as distance from the line increases, and will disappear into background noise levels at distances of 250 to 300 m (750 to 1000 ft) from the center of the right-of-way.† Even in fair weather, 765-kV lines would produce some noise.

How will these noise levels disturb people?

Outdoors–they will occasionally interfere with understanding speech.

People standing outdoors at the edge of the right-of-way will have some difficulty understanding one another if they are standing more than 2.4 m (8 ft) apart when the transmission line noise is the loudest (that is, in periods of heavy rain or snow). During fair weather, no interference will occur.

Indoors–line noise will sometimes disturb sleep.

Relying on data presented in the hearings, the SRI International project team suggests that residences within 150 m (500 ft) of the center of the right-of-way could have unacceptable indoor noise levels (those steady nighttime noise levels above 35 dB). At 150 m the energy equivalent noise level from the transmission line would be about 35.5 dB. However, it would be necessary for bedroom windows to be open for line noise to interfere with sleep beyond the right-of-way, and only some people would have their sleep disturbed.

If lines pass close to communities, noise complaints may follow.

Based on the testimony, the SRI International team suggests that the noise levels at the edge of the right-of-way appear to be high enough that they may result in some complaints to authorities or threats of legal action. Higher income communities and rural communities appear more likely to voice their complaints than lower income and urban communities.

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*A-weighted levels are indicated throughout. Chapter I defines noise terms.

†The utilities requested a right-of-way for the 765-kV transmission lines of 76 m (250 ft) in width. As Appendix A indicates, the New York Public Service Commission provisionally ordered the utilities to acquire a 107 m (350 ft) right-of-way that excludes all residences. The term "right-of-way" throughout this report refers to the 76 m (250 ft) right-of-way described in the testimony.

What is the major controversy in the noise testimony?

Whether the transmission line noise meets suggested EPA guidelines.

High levels of audible noise occur only during foul weather. Such weather is limited to rain, which occurs 3-10% of the time along the right-of-way in New York; fog about 4% of the time; and snow about 5-10% of the time. EPA* has suggested 55 dB L_{dn}† as an upper limit for an acceptable noise environment. Using these guidelines as a starting point, the experts argued about whether to average the noise over 24 hours or over 1 year. The noise from a 765-kV transmission line is 58 dB L_{dn} averaged over 24 hours (the maximum 24-hour average), whereas the noise is 53 dB L_{dn} averaged over 1 year. Unfortunately, the EPA document only suggests averaging times for L_{dn} measurements, and witnesses debated the EPA's intent in setting the 55 dB L_{dn} limit.

More recent studies by EPA and others suggest that 765-kV transmission line noise could cause at least sporadic complaints and possible widespread complaints in certain types of communities, if the lines pass close to the community and it has had little exposure to high noise levels.

What questions are left?

How do we best use the noise data?

The question remains of how best to use transmission line noise measurements to predict whether communities will be disturbed by 765-kV transmission line noise. In addition, better data are needed on how houses, particularly house walls with windows, attenuate transmission line noise. The hearings did not consider whether transmission line noise has characteristics (buzzing or crackling) that are particularly annoying.

Effects of Electromagnetic Fields on Biological Systems

The fields are not strong enough to cause excessive tissue heating, the primary hazard from electromagnetic fields. Nevertheless, the main controversy in this area of the hearings is whether or not biological effects are possible from transmission line fields other than unimportant heating. About two-thirds of all the testimony centers on this hotly contested topic. The witnesses concentrated on potential effects from the electric field.

How strong are the fields?

The electric field is about 10 kilovolts per meter (kV/m) at ground level, and the magnetic field is about 0.6 gauss (G).

These are peak fields directly under a 765-kV line. A field of 2500 kV/m will ionize air to cause corona discharge. These fields decrease rapidly as distance from the lines increases, and drop to about 2.5 kV/m at the edge of the right-of-way 38 m (125 ft) from the lines' center. The peak ac magnetic fields at ground level are about 0.6 G with 4000 amperes (A) per conductor and about 0.15 G with 1000 A per conductor. The earth's magnetic field, which is constant, is about 0.5 G. The magnetic fields also decrease rapidly as distance from the lines increases.

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*Environmental Protection Agency, "Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," EPA 550/9-74-004 (1974).

†L_{dn} is an average of noise levels over a 24-hour period (or longer) that weights nighttime noise more heavily than daytime noise. Chapter 1 describes noise averaging.

Can the disagreements over whether there are biological effects be settled at this time?

Not satisfactorily.

The experiments claimed to support the existence of effects are challenged, with poor experimental design and inadequate statistical treatment of results cited. Effects may nonetheless exist; however, if they do, they are subtle, they are difficult to detect, and they require careful experimentation.

Have electric fields under transmission lines been shown to be hazardous?

No; on the other hand, neither have the fields been shown to be without effect.

It is impossible to demonstrate absolutely that any environmental agent is without effect because an infinite number of experiments on all biological systems would be required. (Only one positive experiment, on the other hand, is required to prove a hazard.) Most of the studies referred to by witnesses in the hearings are not useful for hazard determination, primarily because the effects are as yet poorly understood. For example, although no dose-response relationships between field levels and exposure times have been demonstrated experimentally, such data are necessary for determining whether the fields are hazardous.

Little evidence offered in the hearings indicates that people are adversely affected either at home or at work by electric fields at power line frequencies. This absence of evidence cannot be construed to mean that no effects occur. However, it does imply that if effects take place, they are more subtle than commonly encountered occupational diseases or than diseases resulting from common environmental agents such as urban smog.

What are the difficulties encountered in resolving the question about health and environmental hazards?

It is difficult and expensive to undertake credible experiments.

The experts disagree about whether low-frequency electromagnetic fields cause biological effects at levels under transmission lines. Nor do such disagreements lend themselves to ready settlement; difficult and time-consuming effort would be required to perform better experiments than those available to the witnesses. However, those experimental results that seem to have indicated a "stress response" to exposure to low-frequency electromagnetic fields may, in the absence of careful experiments, indicate that biologic systems respond to the fields. The testimony revealed no systematic studies of the threshold of intensity or the duration of exposure required to produce alleged effects. Such systematic studies must be performed before it can be determined whether or not the fields under 765-kV transmission lines present hazards.

The majority of the research discussed in the hearings, because it purports to show effects, creates an impression in the lay reader that effects are there for even the simplest scientic experiment to display. Such is not the case.

Will these field levels affect biological systems?

The experts disagree vehemently

The witnesses described and examined many claimed effects, including:

- In humans and primates
  - Increased triglycerides in the blood
  - Accelerated bone fracture healing
  - Altered psychomotor reaction times
  - Shifts in the timing of normal daily rhythms
  - Lack of a feeling of well-being
  - Sensations of fatigue, depression and headache
  - Changes in the electrical activity patterns of the brain
- In rats, mice, and guinea pigs
  - Decreased weight gain
  - Altered enzyme levels in various organs
  - Altered levels of steroids in the blood
  - Increased bone growth
  - Bone tumor induction
  - Electrocardiogram phasing
  - Changes in blood cell count
  - Alterations in the concentration of blood chemicals
  - Perception of electromagnetic field
  - Locomotor activity changes
  - Lethality
  - Weight loss in progeny
  - Organ weight changes
  - Water consumption changes
  - Changes in milk production in nursing females
  - Change in litter size
- In miscellaneous species and organisms (dogs, cats, birds, invertebrates, and plants)
  - Cell cycle alteration
  - Alterations in the cell division rate
  - Perception of electromagnetic fields
  - Leaf tip burning
  - Reduction in calcium release from brain tissue
  - Orientation to electromagnetic fields
  - Decreased compensation to stress induction

Many of the experiments described by witnesses involved electric and/or magnetic fields with strengths much greater or frequencies substantially different than ground level fields under 765-kV lines. Some experts claimed that no effects exist (apart from unimportant heating); others recommended that the likelihood of hazards was sufficient to justify the New York Public Service Commission halting construction of the proposed lines.

Sparks and Currents Received When a Person Touches a Vehicle Parked Under the Lines

Just before a person touches a vehicle parked under a 765-kV transmission line a series of small sparks will be felt, similar to those felt when walking across a carpet on a dry day. When someone firmly contacts a vehicle, a continuous 60-Hz current will flow through the body.

What are the magnitudes of the sparks and currents?

The magnitudes vary considerably.

The maximum theoretically possible (worst case) current is about 7.5 milliamperes) (mA) when a well-grounded person touches a tractor-trailer truck parked under a line with a 12.8 m (42 ft) minimum clearance above the ground. Higher line clearances reduce the current. In addition, smaller vehicles generally result in smaller currents. For the proposed New York lines, which are to have a minimum ground clearance of 15 m (48 ft), the maximum theoretically possible current is about 5 mA when touching a tractor-trailor or a large bus.

Measured currents for actual vehicles are frequently 12% or less of the maximum theoretically possible. However, one witness did measure a value in one experiment that was 90% of the theoretical value. Hence, actual currents of 4-5 mA might result if a large vehicle were touched under unusual circumstances (e.g., the vehicle were well-insulated from the earth and the person were in good electrical contact with the earth).

Witnesses disagreed about the theoretical description of the sparks felt when a person touched a vehicle parked under the lines. The energy present in each spark appeared to be the most appropriate indicator of effects. Vehicle voltage can reach well over 1000 V with respect to the ground. A person within a few millimeters of the vehicle discharges the built-up voltage and sparks begin. Spark energies as high as 65 millijoules (mJ) are theoretically possible from touching a tractor-trailer truck parked under a line with a 12 m (42 ft) clearance. However, witnesses argued over what energies would occur in an actual situation. Measured values ranged from less than 0.1 mJ for sedans to more than 1 mJ for trailer-trucks.

What are the effects?

Adults will be startled, but children may be more seriously affected.

Witnesses agreed that adults will occasionally be startled by the currents and sparks they feel when they touch a large vehicle parked under the lines or even at the edge of the right-of-way. The witnesses also agreed that the only danger from the sparks and currents are secondary ones with a person possibly recoiling into moving machinery or falling. However, no statistical description of these possibilities was presented in the hearings, and no cases of such secondary injury to adults were cited in connection with transmission lines.

As levels of current increase, people experience a series of reactions: first, a tingling sensation at the point of contact with currents of 0.5-2.0 mA; then a startle reaction with currents of 1.5 mA and greater (people find currents of 2.0 mA to be objectionable);

finally, as the current becomes great enough (the release current) a person is unable to release the current source because of tetany in the arm muscles. The average release current for adult males is 16 mA and for adult females is 10.5 mA, but it may be as low as 5 mA for small children. Greater currents result in respiratory paralysis and finally in ventricular fibrillation. Respiratory paralysis begins at 18-22 mA for adults, and could be as low as 7-8 mA for children.

The physical reaction to electric currents depends on body size, with small children more affected by smaller currents than adults. For the obvious reasons of safety, little research has been done on the reaction of children to electrical currents. The release current for children is thus not known, but the witnesses theorized, based on extrapolation of data on adults, that it may be about 5 mA for small children. It is not known how much amperage above the release current causes respiratory arrest in children. In two recorded cases, children who came in contact with an 8-mA current (which had nothing to do with a transmission line) died. It appears that the 5-mA current possible under transmission lines under worst-case conditions is close to the suspected release current for small children.

What is the important unresolved question?

The release current for children.

Clearly, the major gap is uncertainty about what constitutes release currents and currents that induce respiratory arrest in children. Nor is it accurately known how much the current that causes respiratory arrest exceeds the release current. If the two currents differ by only a few milliamperes it becomes possible that currents under 765-kV lines might, indeed, under rare circumstances approach the respiratory arrest current for children.

Effects of Electromagnetic Fields on Cardiac Pacemakers

The fields under 765-kV transmission lines may affect some cardiac pacemakers, although the testimony cited no cases of transmission line interference. In fact, data are limited about pacemaker interference from 60-Hz electromagnetic fields and therefore only tentative conclusions are possible.

How do pacemakers respond to electromagnetic interference from transmission lines?

Three responses are possible:

- *Nothing happens*
- *The rhythm or rate intermittently changes*
- *They cease responding to the natural heart rate but continue to pace the heart at an acceptable fixed rate (that is, they revert to a fixed rate).*

Transmission line fields are too small to cause pacemaker dysfunction--operation at an extreme rate, either fast or slow, or failure to send a pacing signal to the heart for a significant time.

Are any of the three ways the pacemaker may react physically important?

Only intermittent changes in rhythm or rate and reversion to a fixed rate of pacing are.

Some pacemakers are sensitive to 60-Hz interference at voltages of about 0.27 to 3.0 mV on the pacemaker lead to the heart. Sensitivity appears critically dependent on the type of lead, the type and brand of pacemaker, and the position and orientation of the person in relation to the transmission line.

The most sensitive pacemakers might revert to a fixed rate of pacing even beyond the right-of-way--as far as 50 m (150 ft) from the center, under conditions of maximum coupling and a sensitive pacemaker with a unipolar catheter.

Are there any medical implications of the pacemaker's reaction to 765-kV transmission line fields?

None, except for certain individuals.

The exception appears to be for those patients who have coronary artery disease or a serious electrolyte imbalance, who experience drug toxicity, or who are subject to ventricular fibrillation. It was claimed in the hearings (although the testimony was striken because the witness was not a cardiac specialist) that ample evidence indicates that if a pacemaker stimulus occurs during a brief period of hyperexcitability in the heart's electrical cycle, serious disturbances of the heart rhythm may be induced, including rapid heartbeat (ventricular tachycardia), or possibly ventricular fibrillation. which requires immediate medical attention.

The testimony suggests that pacemaker wearers who are likely to be harmed by competition with the pacemaker signal would be unlikely, because of their general health, to be moving about in the vicinity of the lines.

What impedes resolving the major uncertainties remaining about hazards to pacemaker wearers?

Data are lacking.

No definitive answer as to how 765-kV power lines might endanger pacemaker wearers emerged from the testimony. Only a very few pacemakers were tested against 60-Hz voltages, with no indication about how this small sample relates to the population of pacemakers. Nor was it clear whether a pacemaker that entered into competition with an intrinsic heartbeat would endanger the wearer.

Plant Damage from Ozone Produced During Periods of High Corona Discharge

Transmission lines produce relatively little ozone, and possible effects are limited to the vicinity of the right-of-way. Atmospheric diffusion and mixing rapidly reduce the concentrations as the distance from the line increases.

How much ozone is produced?

Very little, compared with other contributing sources such as sunlight or automobiles in urban areas.

The maximum rate of ozone production occurs less than about 0.3% of the time during fog or heavy rain and the minimum rate occurs during fair weather.

How much do ozone concentrations along the right-of-way increase as a result?

The most when it is raining and a calm wind is blowing parallel to the line, and much less during fair weather or more wind.

During fair weather, the maximum concentration increase would be only about 0.25 ppb. Background concentrations vary from 8 ppb to more than 150 ppb. During rain, snow, or hail, the maximum concentration increase would be 7-9 ppb, but background concentrations would peak below about 100 ppb.

Will these increases damage plants along the right-of-way?

No.

No damage to plants from ozone production by transmission lines has been found because the increases are highly variable and small compared with the ozone background. The maximum increases of the 7-9 ppb produced by the lines occur very infrequently and then only during heavy rains accompanied by very slow wind that blows exactly parallel to a long stretch of transmission line [more than 1.5 km (1 mile)]. Even under these conditions, roughly 10 hours are required for the concentration to build up to the 7-9 ppb level.

Will increase in ozone concentration from line operation violate air quality standards?

It is unlikely.

The National Ambient Air Quality Standard for ozone is 120 ppb, not to be exceeded as a peak 1-hour concentration on more than 1 day per year. The air quality along the proposed New York State right-of-way frequently violates this standard during fair weather when the ozone background is highest. Moisture in the air during foul weather reduces the ozone background so that even the peak addition from the transmission lines would not cause violations of the air quality standard. The atmospheric conditions of a stable wind blowing parallel to a long stretch of line for several hours during heavy rain would be infrequent enough that further violations of the air quality standards, already occurring from other sources, would be unlikely.

What data gaps and unresolved questions about ozone remain?

No new measurements are needed.

Measurements were completed to confirm the primarily theoretical results presented in the hearings. Measurements are difficult owing to the relatively small concentration increases produced by the lines and to the variations in ozone production during weather and in the ozone background.

Recommendations

The SRI International project team recommends the following research:

- On audible noise from 765-kV and higher voltage systems:
  - Develop data on costs and methods of reducing noise impacts
  - Develop further methods of deciding when noise levels are unacceptable by gathering survey and complaint data
  - Refine the method for using AN measurements
  - Make provision for processing complaints on audible noise.
- Although available evidence indicates that electric fields do not present a serious hazard to human health or well-being, DOE should consider a research program aimed at allaying public concern about the possible hazard. From our review of the testimony at the hearing, we suggest the following program on potential biological effects from the electromagnetic fields under 765-kV and higher voltage systems. The DOE is already supporting much of this work:
  - Include repetition of experiments showing "effects," with careful attention to experimental design, including exposure conditions and field characterization. This will ensure that experiments meet adequate statistical criteria and avoid results due to experimental artifacts
  - Include in the design of new experiments additional studies suggested by conclusions drawn from the earlier experiments (e.g., "stress")
  - Include in the design of new experiments a systematic study of threshold intensities and the dependence of the magnitude of the effect on field strength
  - Consider in the experimental design, when proposed experiments involve human subjects, the variability of response among individuals, and the existence of the exceptionally sensitive or resistant individual
  - Prepare experimental designs that are useful for hazard determination as opposed to effect determination. Given the experimental uncertainties currently surrounding the effects research, it may be some time before such experiments are possible
  - Keep funding and review of the experiments independent to ensure credibility
  - Distribute research results widely to encourage broad comprehension of significant results
  - Review the advisability of setting edge of right-of-way standards that make the electromagnetic fields equivalent to those present at the edge of the right-of-way of current systems.*

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*This recommendation is also discussed in R. S. Banks et al., "Public Health and Safety Effects of High-Voltage Overhead Transmission Lines: An Analysis for the Minnesota Environmental Quality Board," Minnesota Department of Public Health (October 1977).

Issues Not Examined in the New York Hearings

The hearings address several important issues. However, important issues are left unexplored, including:

- Right-of-way construction and maintenance
- Visual impacts of large towers
- Radio and TV interference
- Siting and routing procedures
- Public involvement in siting
- Land-use trade-offs, particularly routing of lines across farm land
- Social and institutional trade-offs between 765-kV and alternative systems, such as dc overhead and multiple lower voltage lines
- Liability for environmental effects resulting from line operation
- Power system effects such as reliability and cost.

These issues must also be considered as part of a comprehensive evaluation of 765-kV and higher voltage transmission lines.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Billings Area Office
316 North 26th Street
Billings, Montana 59101

IN REPLY REFER TO:
SE

6-1-81-F-218

April 10, 1981

Mr. Jerry Frick
Engineering Manager
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

Dear Mr. Frick:

This is the Fish and Wildlife Service's (FWS) biological opinion prepared in response to your February 13, 1981, request for formal consultation on the Bonneville Power Administration's (BPA) Colstrip 500 kV transmission project between Townsend and Garrison, Montana, and the endangered bald eagle (*Haliaeetus leucocephalus*). The FWS has examined the proposed action in accordance with the Section 7 Interagency Cooperation Regulations (50 CFR 402, 43 FR 870) and the Endangered Species Act (ESA) of 1973 as amended.

Biological Opinion

It is the Service's biological opinion that the proposed transmission project from Townsend to Garrison is not likely to jeopardize the continued existence of the bald eagle.

Project Description

The proposed project is a segment of 430 miles of transmission line required to integrate power from two 700-MW coal-fired power plants at Colstrip, Montana, into BPA's Pacific Northwest Power Grid. The transmission facilities will consist of two parallel 500-kV transmission lines from Colstrip to Townsend and a double-circuit 500-kV transmission line from Townsend to Garrison. BPA is responsible for the latter portion. The double-circuit towers in the BPA segment will be approximately 165 feet tall, constructed in a stacked configuration design with double overhead ground wires, and will require a right-of-way of 125 feet. The line will cross the Missouri River approximately midway between Townsend and Toston, in T. 6 N., R. 2 E., Sec. 28. Construction is scheduled for spring of 1982 to fall of 1983.

Basis of Opinion

The proposed Missouri River crossing passes through the edge of the Holker bald eagle roost and between the roost and feeding area below Toston Dam. Eagles occur in this area during migration and winter, particularly during severe cold weather when the outflow from Toston Dam maintains open water for about eight miles downstream (Wenzel, 1981 pers. comm.). West of the river, the transmission line also crosses Stanfill's Slough, an open water area used by wintering waterfowl which are likely a food source for the wintering eagles (Thompson 1981 pers. comm.). The dense cottonwoods of the Holker roost are the closest suitable roosting habitat for eagles feeding at these sites.

Waterfowl killed or crippled by collisions with the transmission line would provide additional food for eagles but may also increase the potential for secondary lead poisoning. Lead poisoning in waterfowl has been fairly low in the Missouri River area of Montana but is increasing at Benton Lake and Freezeout Lake, the nearest areas for which data is available (Malcolm 1981 pers. comm). However, at present the incidence of lead poisoning in the waterfowl occurring in the project area is judged to be minimal (Childress 1981 pers. comm).

No data is available on the total number of wintering and migrant eagles utilizing this stretch of the Missouri. The highest count from Townsend to Toston, from the National Wildlife Federation's 1979 midwinter survey, was 16, out of a total of 461 bald eagles statewide. The Bureau of Land Management estimates the population size of bald eagles using the crossing area as 50-100 eagles, based on the literature and their own data (Fox 1980).

Construction of the transmission line at the proposed Missouri River crossing site may adversely affect the eagle through disturbance during construction, habitat destruction associated with right-of-way clearing, and direct mortality resulting from collisions with the conductor lines and overhead groundwires. Our opinion is based upon consideration of these potential impacts and their significance to the survival and recovery of the bald eagle.

Construction activities in the vicinity of the roost and feeding areas would likely cause temporary displacement of bald eagles during the winter and migration period. To prevent such disturbance, your proposal to avoid construction from October 15 through March 31 should be implemented.

Clearing of the proposed 125-foot right-of-way will result in a loss of riparian perching and roosting habitat. Cottonwood trees are limited between the proposed crossing site and the Toston Dam outflow. Thus, removal of trees at the Holker roost would likely force eagles to move north, further away from feeding sites. Steenhof (1978) identifies proximity to a food source as probably the most important factor influencing diurnal perch selection but not a critical factor for winter roosts. Although it is difficult to predict at what point the distance to roosting and perching habitat would preclude use of the feeding sites, we believe the eagles would be able to relocate to the nearest suitable habitat. However, clearing the right-of-way would further reduce the already limited habitat.

High voltage power lines pose a collision hazard to bald eagles. During fair weather conditions, the presence of power lines should be apparent to eagles. However, during strong winds or poor light conditions, the potential for accidents near communal roosts is considered high (Steenhof 1978). Based on studies of other bird species, Meyer (1979) concluded that transmission lines with a stacked configuration and overhead groundwires cause greater mortality than a flat-type configuration. Most observed collision mortalities occured with the overhead groundwires; the bundled conductor wires of high voltage powerlines are readily visible. These studies were not conducted in areas frequented by bald eagles. During an ongoing study of a delta configuration line in the vicinity of wintering bald eagles, eagles were observed adjusting their flight altitude to avoid powerline contact (Meyer 1981 pers. comm.).

Based on the above discussion and our review of the available information on bald eagle collision mortality, we believe that the probability of significant losses resulting from collisions with the proposed transmission line crossing is low. Though some mortalities may occur, the loss of eagles and habitat should not be at a level that would jeopardize the continued existence of the bald eagle. However, the ESA also directs Federal agencies to carry out programs for the conservation of endangered species. With regard to the bald eagle as well as other wildlife species, BPA has selected as the crossing site one of the most sensitive locations between Townsend and Toston. Implementation of the following recommendations to alleviate habitat loss and collision mortalities should receive serious consideration.

Recommendations

The FWS believes that relocation of the crossing combined with changes in tower design will substantially reduce all of the impacts discussed above. The line should be relocated to avoid the Holker roost and Stanfill's Slough. A site approximately one mile south of the present proposed location (as recommended by the Montana Department of Natural Resources) should be considered. The suitability of other locations should be discussed with FWS and DNR. The towers should be constructed in a flat, horizontal configuration with the overhead groundwires eliminated.

If, after consideration of other alternatives, BPA determines that relocation of the crossing is not feasible, the towers should be constructed as presently proposed (stacked configuration). Although a flat, horizontal design would reduce the collision potential, this would require at least twice as much right-of-way and, consequently, would adversely affect the habitat of bald eagles and other wildlife species. To reduce collision hazard, overhead groundwires should be eliminated. Removal of cottonwoods and other riparian habitat should be kept to a minimum and cottonwoods reestablished where possible. The potential for planting of cottonwoods to provide future perching and roosting habitat in upstream areas devoid of such vegetation should be investigated.

This completes the FWS biological opinion on BPA's proposed Townsend to Garrison 500-kV transmission line. If additional species are listed or conditions of the proposed work change, reinitiation of consultation with the FWS should be considered.

We appreciate your cooperation and interest in meeting our joint responsibilities under the Endangered Species Act.

Sincerely,

Wally Steucke

Wally Steucke
Area Manager

References Cited

Childress, D. 1981. Personal communication. Montana Department of Fish, Wildlife, and Parks, Fairfield.

Fox, L. 1980. December 22 letter to Jim Meyer, Bonneville Power Administration.

Malcolm, J. 1981. Personal communication. U.S. Fish and Wildlife Service, Billings.

Meyer, J. 1981. Personal communication. Bonneville Power Administration, Portland.

_____. 1979. Northwest Montana/North Idaho transmission corridor bald eagle study. Bonneville Power Administration, Portland.

Steenhof, K. 1978. Management of wintering bald eagles. USDI, FWS. 59 pp.

Thompson, L. S. 1981. Personal communication. Montana Department of Natural Resources.

Wenzel, E. 1981. Personal communication. Headwaters Resource Area, Bureau of Land Management.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Billings Area Office
Federal Building, Room 3035
316 North 26th Street
Billings, Montana 59101-1396

IN REPLY REFER TO:

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September 9, 1981

MT 2SB OXT 1 003640

District Engineer
U.S. Army District, Omaha
Corps of Engineers
P.O. Box 5
Omaha, NE 68101

Dear Sir:

We have reviewed Notice of Permit Pending No. MT 2SB OXT 1 003640 for Bonneville Power Administration (BPA) to provide for installation of an overhead transmission line across the Missouri River at mile 2286.00.

As stated in the Notice, it is not anticipated that any fill material will be placed in the waterway. We understand also, that the support towers adjacent to the river will not involve placing of fill in nearby wetland areas.

We are quite concerned about the proposed location of the line across the river. This concern has been previously expressed to BPA in various correspondence and during informal discussions. The crossing is in an area heavily used by waterfowl. Various raptors, including the bald eagle and the osprey, occur. Great blue heron rookeries also occur nearby. Miscellaneous water birds and passerines are seasonally abundant.

It appears that, through line strikes, the power line will result in chronic, though quantitatively unknown, mortality of birds. We have explored means of eliminating or reducing this hazard with BPA and other interested agencies. Unfortunately, the Permit Notice was issued very late in the planning process for the line. It appears that, at this stage, severe schedule disruptions, increased costs, and other problems preclude any consideration of "moving" the proposed line crossing to another location. Further, removal of the static wires (which, according to a literature review and discussions with specialists, present a greater hazard to birds than do the conductors and other structures involved) appears impractical because of the high risk of lightning strikes in the geographic area involved. We understand that, geographically speaking, the lightning risk is high and is further complicated at the crossing by the increased height of the towers (required at the river to attain necessary clearance).

In view of the foregoing and the fact that the FWS, in its biological opinion concerning the bald eagle, determined that the overall project would not jeopardize the continued existence of the bald eagle, we do not oppose issuance of the requested permit despite the concerns we have expressed.

On September 3, 1981, representatives of several agencies met at the power line crossing site. Several measures were adopted that are intended to reduce the severity of impacts within practical limits imposed by the circumstances. These measures include: 1) marking the static wires with 9-inch balls to increase visibility; 2) minimizing clearance of riparian vegetation during construction of the line; and 3) carrying out construction within a period between June 15 and September 15 to minimize disturbance of nesting and other avian activities at the site. In a letter from BPA to this office dated September 8, 1981, that agency commits itself to these measures (a copy has been sent to your office), and refers to understandings arrived at with respect to future coordination regarding the measures, as well as an agreement to pursue a possible monitoring/evaluation program at the site. We request that BPA's letter and these comments be made a part of the permit record.

These comments represent the position of the Department of the Interior.

Sincerely,
/s/ Robert M. Ballou

Robert M. Ballou
Acting Area Manager

cc: Larry Thompson, Montana Department of Natural Resources, Helena, MT ✓
Director, Montana Department of Fish, Wildlife, and Parks, Helena, MT
Jeff Herbert, Montana Department of Fish, Wildlife, and Parks, Townsend, MT
Gary Gebhart, BLM, Billings, MT
James Meyers, BPA, Portland, OR
Regional Director, USFWS, Denver, CO (ENV)

Appendix E

MONTANA HISTORICAL SOCIETY
HISTORIC PRESERVATION OFFICE
225 NORTH ROBERTS STREET • (406) 449-4584 • HELENA, MONTANA 59601

May 14, 1982

Ms. Gloria J. J. Lenz
Environmental Specialist
Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

Dear Gloria:

Based on correspondence that we have received from Archaeological and Historical Services, we would like to use this letter to summarize our findings and questions on the cultural resource identification, evaluation, and assessment of effect work that has been done to date on the Bonneville Power Administration's proposed Garrison to Townsend line.

As Archaeological and Historical Services noted, we have concurred with you in the eligibility of eight sites which you identified as part of BPA's inventory of the project area:

Comet
Grey Eagle Mining Complex
Morning Glory Mine
Boulder Lime Company Kiln
Two Dry Creek Prehistoric Sites
Efraimson Homestead
Zimmerman Homestead

The Keeper of the National Register has officially agreed to our mutual recommendations of eligibility on all of the sites listed above, with the exception of the two homesteads, which he is now reviewing. We have forwarded to the Register office our comments on the significance of those homesteads.

Of the sites that you identified in your survey, the National Register eligibility of one remains in question. We find that one portion of the Mullan Military Wagon Road which the line is designed to cross is eligible for the National Register; you do not. The Keeper should also be reviewing our two different opinions on that site. He has up to 45 days in which to reach that decision.

Once the eligibility of cultural resources has been established, Federal regulations then require you to establish the effect of the project on those resources and consider ways to avoid or mitigate potential adverse effects. This second process requires our comments, but is ultimately presented to the Advisory Council on Historic Preservation, (ACHP) a Federal preservation agency.

A summary of our assessment of the effect of the proposed project on the nine sites just described follows.

In considering the impact of the line on cultural resources between Garrison to Townsend, we find that, in order of importance, the following impacts or effects appear the most important to consider:

1. Visual impacts, changes to significant historic settings.

2. Likelihood of vandalism occurring to historic sites during construction.

3. Likelihood of greater vandalism from the public after construction due to increased ease of access or familiarity with travel corridors.

4. Introduction of noise intrusions in significant historic settings.

5. Physical change or impairment of historic sites or structures in the course of construction.

Physical impairment of any of the nine sites does not appear likely, with the slight exception of the Dry Creek sites, on which official findings of no adverse effect have been sent by both our offices to the Advisory Council on Historic Preservation. Visual impacts, the potential for vandalism, and noise impacts are the primary effects that, based on the information now available to us, historic resources may suffer. All three, again relying on present information, are difficult to assess in precise, measurable ways. The outline below represents our best current assessment of impacts or effects to the remaining seven sites on which findings of effect must be reached for compliance with Federal historic preservation regulations. In most instances, our assessments of effect are made conditional on the presentation by your agency to the Advisory Council of additional information for their use in reviewing the project. While our office could seek to review that kind of material first here; providing it directly to the Advisory Council, while sending a copy to our office, permits the Council an earlier opportunity to comment.

Grey Eagle Mine Complex:

- SHPO conditional recommendation of no adverse effect, based on the current assurances that the present transmission line disrupts the historic setting so that additional visual intrusions will not result in a substantially greater loss of integrity of setting.

- The condition of our recommendation is that you provide the ACHP with photographs looking to the site from several angles and looking from the site at several angles, with the line, in scale in proportion to the photographs, drawn into the pictures. If this technique is not feasible at all, we urge the use of any other precise line-of-sight measuring and depicting techniques.

- In light of the potential for vandalism to happen during construction, we recommend that the no adverse effect finding also be based on (a) monitoring of the site during the construction period to insure that no trespass of the buildings occurs and (b) placement of a requirement or a bond on the contracting firm(s) insuring that they be responsible for any action taken by an employee which harms the historic resources. A monitoring program should be done in part by cultural resource specialists and be systematic.

Boulder Lime Kiln:

- SHPO conditional recommendation of no adverse effect. We disagree with the consultant's statement that setting was not a contributing element of significance in the National Register elgibility determination. The Register material describes the resource's undisturbed historic setting. However, we concur that setting is not as critical a part of the site's value as is the case in several other resources on the line.

- The condition of our recommendation is as described above under Grey Eagle, with the presentation of photographs on which scaled renderings of the line have been placed.

- In light of the potential for vandalism during construction, we also recommend that the monitoring and bonding of contractors described above be instituted.

Comet:

- SHPO conditional recommendation of no adverse effect, based on current assurances that the line will not be visible from anywhere within the eligible site and that construction activity will not significantly increase vandalism during or after construction.

  Comet is the most complex and significant site with structures identified during the inventory process. Ghost towns in Montana are intrinsically susceptible to vandalism. While current mining and timber harvesting in the area of Comet make access for vandalism relatively easy, we consider the increased potential for vandalism to be very serious during construction itself.

  Second, our review of the line location on a USGS map in relationship to the town makes it very difficult to be certain that no view of the line is possible from Comet. It would appear very likely that the line is visible from the top of the milling structures at least or looking up the coulee which runs through the town. For a complex of its size, Comet retains a high degree of site and setting integrity, the loss of which would be significant.

- Hence, our conditions include presentation of the photographic series described above with the line and towers drawn in, and

- The requirement for very strict monitoring or construction assurances or bonding, to prevent vandalism. This requirement is even more important at Comet. We would suggest that some monitoring be done, under contract, by Comet's owner himself, perhaps in conjunction with cultural resource personnel.

- The photographic evidence here should be very actively reviewed with consideration of line moving as a possibility if the line is visible from locations in Comet.

Morning Glory Mine Complex:

- SHPO conditional recommendation of no adverse effect. The line here passes directly over the historic complex, but apparently at an elevation so far above the gulch in which the site is located that it would not be visible from among the structures without looking directly overhead. Also, construction work in that immediate area poses the possibility of vandalism during construction.

- Hence, our conditions for the recommendation include presentation of photographs as described above with exact line appearance imposed on them and,

- The requirement for monitoring of the site during construction and for seeking assurances or bonds from the contractor that no employees will trespass on the historic resources.

- We do not believe that the aural aspect of the site contributed to its National Register eligibility and so do not recommend that noise intrusions be addressed.

Efraimson Homestead:

- SHPO conditional finding of no adverse effect. We disagree with the consultants finding that the visual impact of construction of the transmission line within one quarter mile of this site will constitute minimal visual impact. Although we find the historic setting of the Ephraimson Homestead to be of clear importance, we cannot now determine how major an intrusion the line will cause in the cleared land setting.

- Hence, our condition is again that BPA provide the Council with photographs looking from and toward the site with scaled renderings of the line superimposed.

- The reconstruction of the existing roadway to this site to provide access for line construction crews does not of itself, in our judgment, constitute an adverse effect, physically or visually. However, we condition our recommendation for no adverse effect also upon assurances that site monitoring during construction and protective measures such as bonding of construction workers be undertaken as outlined for sites previously discussed. The property owner, again in this case, may have an interest in participating in the site monitoring activities.

Zimmerman Homestead:

- SHPO conditional recommendation of no adverse effect. The historic setting was a primary factor in the determination of the Zimmerman Homestead's National Register eligibility. However, we are again at a loss to measure the degree of change that will occur to the setting without more precise information. Our condition then requires presentation to the Council of photographs with the line imposed them accurately.

- The increased access especially during the construction period, has the potential to allow for increased incidences of vandalism. Again we recommend that site monitoring and bonding of the construction firm be instituted to curtail potential impacts during the construction phase.

- We also recommend that the existing 20 foot wire gate be maintained and used to inhibit access to the site after construction.

Mullan Road:

- If the Keeper determines this portion of the Mullan Road eligible, we find that the crossing of the line will have an adverse impact on the qualities that would make the Road significant. As with many resources associated with 19th century Western historical themes, historic value was and is more associated with historic setting than with specific manmade evidences. Hence, in proportion to the site's value, placement of a line of this dimension in the center of a stretch of historic road alignment relatively undisturbed by intrusions on its sky line is a major adverse effect.

- Prior to acceptance of this adverse effect in a memorandum of agreement, we would urge consideration of moving the line to a portion of the Mullan Road that is less historically intact or, if that is not possible, full color photographic recording of this stretch prior to line construction.

Let me then summarize our current findings of effect on the nine resources identified through your survey efforts and under consideration as eligible for National Register listing. The project is judged not apt to effect adversely the two Dry Creek prehistoric sites with the requirement for monitoring. Your recommendation to that effect and ours have already been sent to the Advisory Council on Historic Preservation. On the remaining seven historic sites, we believe that vandalism during construction and visual intrusions constitute the most likely impacts to occur, with the potential to be adverse. In all cases, the settings of the historic resources were identified, in the determination of eligibility process as contributing to the value of the sites. (Please see the attached correspondence.) Hence, visual impacts warrant consideration. We have here made conditional no adverse effect determinations. Our recommendation or the Council's should change if, more visual, graphic portrayal of how the line will actually appear looking from and toward the sites in question illustrates a great deal of visual change in the settings. Your consultants have consistently assured us that, based on topography or tree cover, those impacts will be slight. A finding of no adverse effect is warranted if the visual documentation substantiates that case. Of the seven historic sites being considered, we judge--based largely on the sheer dimensions of the sites and what we know to be topography--that closest attention should be paid to visual impacts at Comet and on the Mullan Road.

Finally, in our discussion of effects and impacts, we would urge you to spell out for the Advisory Council and for our office the potential for and nature of a variety of other activities which could harm cultural resources. We have heard only general information about those actions or impacts. They include the degree of potential for fire from sparks from the line, during construction or thereafter; relationship of blasting to be done for tower construction to historic sites; and the question of whether all tower construction, placement of equipment, moving of equipment, etc., will occur only with the land areas surveyed for cultural resources. We note, for instance, that in the development of compliance mitigation procedures for coal mine plans affecting Eastern Montana specific consideration is given to the impacts of blasting on standing structures (windows, chinking, frames) and rock art sites. If blasting is likely to occur, the Office of Surface Mining both records historic buildings and adopts a monitoring program to measure the effects of blasting as mitigation measures. We believe that you need to make a clear statement of the extent and likelihood of such actions occurring and, if they will occur near historic resources, propose mitigation measures.

In this summarizing letter, we would urge your serious examination of BPA's full consideration of the visual impacts of the line to resources that lie outside the 125 foot corridor surveyed by your consultant. As spelled out in 36CFR800, it is BPA's responsibility to be certain that they have identified all resources on or eligible for the National Register that fall within a project's area of potential environmental impact. In virtually no project do project boundaries coincide with the land area in which environmental impacts resulting from the project can occur. Given the height of the line and its towers, we would judge that to be especially the case in your project.

The question of visual impacts to resources outside the 125 foot survey corridor must be addressed in two parts. First, are there visual impacts to cultural resources that have not yet been identified or evaluated? Second, are there visual impacts to cultural resources that have been identified and evaluated as Register eligible (including those listed in the National Register)? In the first case, there seems to be sufficient information on likely, but unevaluated historic resources outside the corridor to warrant your serious reevaluation of the adequacy of your cultural resource survey efforts. We note, for instance, that the Red Rocks Ranch site was identified to us and to you by the owners as having historic significance. It appears to fall within at least the area of an access road and may be within sight of the line. Also, the 1981 overview prepared for you by Archaeological and Historical Services identified, based on literature only, several sites within a half mile of the line, many of which might be within sight of the line.

Second, on pages iii and iv of the draft survey report prepared for you in 1982 by Archaeological and Historical Services, the consultants note properties listed or eligible for the National Register of Historic Places that fall within the general project area. The report goes on to indicate that while the line may be visible from some of those properties it will--in a blanket statement--not affect the significant qualities of those sites. We strongly urge that you undertake a site-by-site analysis of those visual impacts. We note, for instance, that the setting of Grant-Kohrs Ranch National Historic Site was very significant in its designation within the National Park System. Likewise, the setting of Boulder Hot Springs (not specifically the issue of what could be seen from the Hot Springs, but certainly the property's general setting) was a factor in Register significance.

In considering the question of yet unidentified or incompletely considered visual impacts to significant cultural resources, we are more than aware that the effect of the project must be weighed against the qualities that make a site significant and that setting does not contribute to the significance of all cultural resources. 36CFR800, however, requires first that all cultural resources that fall within the potential environmental impact area of a project be identified and evaluated. Thereafter, an assessment can be made of whether setting contributes to the Register eligibility of those resources and whether the project will affect that setting.

We think that one additional compliance question needs to be answered. We understand that one or more portions of the line have not been surveyed due to owner access questions and that access road locations continue to change. Please spell out for our office and the Advisory Council, your schedule for insuring that cultural resource survey occurs on all tracts that may still be affected and the potential you will have to plan avoidance or mitigation measures if significant cultural resources are identified during those surveys.

We recommend that you now seek findings of effect on all the known sites discussed above from the Advisory Council on Historic Preservation. We urge you to supply them with the documentation that we have received and the additional material and discussion that we describe. You will need to forward this letter to them with your assessment of effect. Further, we strongly urge you to reevaluate the scope of your consideration of cultural resources to be certain that you have considered all cultural resources that might fall within the project's area of environmental impact.

Please call if you have questions. We will be glad, for instance, to discuss with you the system for developing photographs with line and tower locations imposed.

Sincerely,

Marcella Sherfy
Deputy SHPO

cc: Craig Holstine

Tim Murray

MONTANA HISTORICAL SOCIETY
HISTORIC PRESERVATION OFFICE
225 NORTH ROBERTS STREET • (406) [illegible] • [illegible]

May 5, 1982

Ms. Carol Shull
Acting Keeper of the Register
National Park Service
Washington, D.C. 20240

Dear Ms. Shull:

Re: Ephraimson Homestead 24JF672
Zimmerman Homestead 24JF671
Mullan Military Wagon Road 24PW 217

I concur with the Bonneville Power Administration's finding that the Ephraimson Homestead (24JF672) and the Zimmerman Homestead (24JF671) are eligible for listing in the National Register of Historic Places. Both sites illustrate well late homestead period settlement and the industrious undertaking of subsistance farming in the mountainous region of the Boulder River drainage, an area long valued and previously developed for its mineral resources. Relative to other intensively used and long abandoned homestead sites in the State, the Ephraimson and Zimmerman homesteads possess a high degree of historic integrity. The materials and techniques of construction are highly representative of this period of homestead settlement. Hewn, corner notched timber and a sparing amount of rough sawn lumber was used to construct the residences and outbuildings, indicating the availability of mill-worked materials but its use tempered by the limited capital resources of the settlers. The remains of a number of outbuildings, root cellars, corrals and fences indicate that diversified farming/stock raising operations were pursuant to each site. Andrew Ephraimson in 1924 and Clara Zimmerman in 1922 had claimed and obtained patent on what little open river bottom land that was available and suitable for agriculture. The natural landscape and historic setting adds substantivel to the associational significance of both abandoned homestead sites. Neither modern intrusions nor recent remodellings have undermined the integrity of either site.

We also find the Mullan Military Wagon Road to be eligible for listing in the National Register. The Mullan Road played a very significant role in the exploration and settlement of Western Montana and the northwest region in general. Built between 1859-1862, the Mullan Road represents the first significant federal effort to survey and develop an established transportation route in Montana. The War

Department authorized the construction of the wagon road to connect Fort Benton (head of navigation on the Missouri) with Walla Walls, Washington (head of navigation on the Columbia). Lt. John Mullan was awarded the contract and commenced his survey of the route in 1859. An estimated 20,000 Fort Benton to Washington Territory emigrants travelled this road and probably an even larger number followed the route on the return flow occasioned by the Montana gold rush of the 1860s and 1870s. Because the road was extensively used by wagons and pack trains for only a brief span of years during the mid-19th Century, physical evidence of its construction and usage is difficult to discern today along many stretches.

This office plans to prepare a thematic nomination to the Register which includes those segments of the Mullan Military Wagon Road which have retained a high degree of historic integrity. The primary measure of historic integrity for this road along which few physical remnants are likely to be found is visual continuity offered by the preservation of the original, historic landscape. The Mullan road traverses the western third of the State, winding through canyons, over mountain passes, and across rolling, arid prairie land. As one of the earliest major transportation routes in Montana, many sections of the Mullan Road have been utilized for improved county roads, overlaid by interstate highway, or chosen for pipeline or transmission line corridors. We have been working with Dr. Buswell of Helena in plotting the wagon road's route through Montana using Mullans' original 1860's survey maps and the 1870/71 Government Land Office township survey maps as guides. In his conscientious research, Dr. Buswell has found the GLO maps to be exceedingly accurate; field checks have revealed remnants of road cuts, evidence of wagon ruts, and an accurate orientation of the mapped road to significant natural landmarks. At this time, it appears that six segments of the Mullan Military Wagon Road have retained excellent integrity of setting and are worthy of nomination to the National Register.

Although we have not had the opportunity to field check the portion of the Mullan Road now under consideration in section 28 of T9N; R10W, local informants indicate that a relatively lengthy section of the Road between Gold Creek and the commencement of the county road in Mullan Gulch has retained primary integrity of setting, looking today very much as it did to the mid-19th Century engineers. The land is now used primarily for grazing and although cattle trails and a few jeep trails cross the actual road through this area, the historic and visual qualities of the landscape remain intact, even through actual physical evidence of the roadway may be difficult to discern.

We propose that the entire segment of the Mullan Road depicted on the accompanying USGS maps through T9N; R10W sections 6, 7, 8, 17, 20, 21, 33, 34 and T8N; R10W sections 2, 11, 12 be considered in this request for a determination of National Register eligibility.

Because this segment of the road has not yet been systematically surveyed, we propose a 100 foot wide corridor be considered at this time, fifty feet on either side of the marked centerline. Although this boundary does not take into account the important visual aspects of the setting of the Road, we judge such a corridor to include the area of probable intensive historic use, allowing for limited deviation from the recorded roadway. Such a limited boundary line for this resource is only tentative. A wider corridor quite likely will be more appropriate for Register nomination based upon a more careful analysis of the land area necessary to preserve the visual integrity of this significant historic transportation route.

In summary, we support the Bonneville Power Administration's request for a concurrent determination of eligibility on the two homestead sites (24JF672 and 24JF671) and seek a non-concurrent determination on the segment of the Mullan Military Wagon Road described above. In reviewing the Mullan Road we share BPA's judgement that the presence of actual physical remnants of the Road would serve well to strengthen the significance of the resource. But, given the importance of this transportation route in the history of the exploration and settlement of the Northwest region and the fact that a variety of Western historical themes are represented in corridors and settings rather than on-the-ground evidences (e.i. the Lewis and Clark trail and related sites, Yellowstone crossing of the Bozeman Trail, etc.) we find the segments of the Mullan Road that have retained primary integrity of setting to be eligible for National Register listing. One segment of the Road in Cascade County was listed in the National Register on March 13, 1975. The nomination states that this "segment. . .within the Benton Lake Refuge is contained within undisturbed native grasslands. The wagon road, or ruts, if you will, have "healed over" as a result of many years of non-use. The route is identifiable on aerial photographs taken in 1966. It is difficult to identify on the ground." Through some sections of Montana, we expect the preservation of historic setting to be the primary factor determining Register eligibility; in others, remnants of the Road do exist which further substantiate the exact location and significance of the transportation route. I will be glad to discuss with you at greater length our work with Dr. Buswell in locating and describing the Mullan Road's route through the State.

Thank you for your consideration.

Sincerely,

Marcella Sherfy

Marcella Sherfy
Deputy SHPO

PB/det

cc: Jerry Galm

MONTANA HISTORICAL SOCIETY
HISTORIC PRESERVATION OFFICE
225 NORTH ROBERTS STREET • (406) 449-4584 • HELENA, MONTANA 59601

May 12, 1982

Ms. Carol Shull
Acting Keeper of the National Register
National Park Service
Washington, D.C. 20240

Dear Ms. Shull:

Re: Mullan Military Wagon Road
Determination of Eligibility

Enclosed please find copies of the USGS maps which document the location of the Mullan Military Wagon Road through certain sections of land in Powell County, Montana. These maps should have accompanied our letter dated May 5, 1982 which presents our findings of National Register for this segment of the historic transportation route.

Thank you.

Sincerely,

Marcella Sherfy

Marcella Sherfy
Deputy SHPO

PB/det

Enclosures

MONTANA HISTORICAL SOCIETY
HISTORIC PRESERVATION OFFICE
225 NORTH ROBERTS STREET • (406) 449-4584 • HELENA, MONTANA 59601

November 18, 1981

Gloria J. J. Lenz
Environmental Specialist
Department of Energy
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

Dear Gloria:

Re: Garrison to Townsend Line

The Montana Historic Preservation Office is pleased to have the opportunity to review the cultural resource inventory reports for the Garrison to Townsend section of the proposed Bonneville Power Administration transmission line. We concur with the project historian' findings that the Boulder Lime Company Kiln, the Morning Glory Mine Complex, the Gray Eagle Mine Complex and the town of Comet appear to meet the criteria for inclusion in the National Register of Historic Places. However, we do not find the Mount Thompson Mine to possess qualities which would make it eligible for National Register considerati The historic remnants from earlier mining activiites at the Mount Thompson Mine apparently have been obliterated in the course of more recent mining operations at this site. Our comments on the significance of the four potentially eligible properties follows.

The Boulder Lime Company Kiln exhibits the features typical of a moderate sized lime producing operation in Montana: the techniques employed in construction and the functional relation of the quarry, ovens, tailing's, and loading ramps are still very apparent. The fact that no new roads or other modern intrusions have been constructed since the Kiln ceased operation lends the site remarkably good integrity The Boulder Lime Company Kiln represents a locally significant business endeavor which bolstered the local economy and provided nearby ore smelters with a product essential to their continued operations.

The Morning Glory Mine was a small, consistent producer of precious metal-bearing ores from 1919 to the late 1950's. The extent complex of interrelated components are commonly found at lesser mining sites in Montana and include adits and shafts, a flotation mill, workers residences, workshops, garages, and trash middens containing materials associated with mining camp life. The Morning Glory Mine complex is highly typical of the isolated early 20th century mining camp in rural Montana, we find this site to possess qualities which make it a coherent and distinquishable entity with very good integrity of design and setting.

The town of Comet and the associated flotation milling operation is one of the least disturbed abandoned mining complexes in Montana.

The local economic impact of this mining operation was considerable; the Comet mine produced a significant quantity of high grade ore and the 200-ton flotation mill constructed during the 1930's serviced numerous other mining operations in the vicinity as well. The historic district gains additional significance by association with two regionall important financers and mining magnates: Samuel T. Hauser and Daniel C. Corbin. The large number of early structures remaining at the Comet townsite have experienced a fair degree of vandalism as well as natural deterioration, yet still vividly recall the prosperity of the early mining industry which played such a significant role in the development of the State.

The Gray Eagle Mine was also an important early silver, gold, and lead producer dating back to the 1890's. Ore from the Gray Eagle mine was processed at the nearby Comet Mill. Although lacking individual distinction the extent structures and mining features at the Gray Eagle Complex represent a distinguisable entity with very good integrity of design and setting.

In addition to the associational historical value and architectural integrity possessed by each of these three mining complexes, the potential to yield important information about the influence of changing economic circumstances on the conditions at the mining camps, the effects of advancements in mining technology, and the general patterns and lifeways of miners from the late 19th through 20th centuries. As evidenced by the remains of the early material culture present further enhances the value of these sites and their worthiness for preservation.

A ten-day concurrent determination of eligibility for the four properties found to be potentially eligible may be requested from the Keeper of the Register pursuant to 36CFR63.3. USGS maps outlining the site boundaries ought to be included with site reports and photograph in this determination request. A copy of this letter may serve as our comments on the eligibility of these properties for the Keeper's review. Once the official determinations have been made by the Keeper, we may proceed to identify officially the impacts the proposed constructi of the transmission line may have upon the historic integrity of these sites and seek determinations of effect from the Advisory Council on Historic Preservation. Plans for avoidance or mitigation of potential impact may be drafted by your office in consultation with this office and the Advisory Council on Historic Preservation.

If you have any questions about the process or comments please feel free to call.

Sincerely,

Marcella Sherfy

Marcella Sherfy
Deputy SHPO

PB/det

APPENDIX F
Public Hearing Participants

Persons Testifying

Agency Representatives

Ron Wilkerson - Bonneville Power Administration
Earl Reinsel- U.S. Foret Service
David Darby - Bureau of Land Management
Jerry Frick - Bonneville Power Administration
Leo Berry - Montana Department of Natural Resources and Conservation
Bob Robinson - Montana Department of Natural Resources and Conservation
Sandra Muckleston - Montana Department of Health and Environmental Sciences
Hal Robbins - Montana Department of Health and Environmental Sciences
Fred Shewman - Montana Department of Health and Environmental Sciences
Dr. Roger Thorvilson - Montana Department of Health and Environmental Scienc

Proponents

John Peterson - Montana Power Company
Don Gregg - Montana Power Company

Opponents

Lee Tavenner
Larry Lattin*
Paul Peterson
Sean Sheehan
Robert Van Der Vere
Secretary of State Waltermire*
Harriet Spurlock
Attorney General Greeley*
David Rieder
Elizabeth Ferris
George McRae*
Jan Rappe
Philip M. Barrett*
John Lewis*
Gail Peterson
Joe Brand
Paul Smith*
Allie Jensen
Richard J. Llewellyn
Stewart Lewin
Toni Kelly
Mark Lanthorn

*Written statement submitted

Written Statements Received from:

Franz Linjanen
Stuart Hauptman
Adele Furby
Mike Conm
Rita Conn
Michele Sare
North Boulder Protective Association
Judy Hogan
Gold Creek Residents
Gold Creek Homemakers Club
Thomas J. Hogan
Robert Deschamps
Tom Dawson

Letters Received from:

Jed Stanfill
D.D. Davis

APPENDIX G

CONSTRUCTION STANDARDS FOR 500 KV TOWNSEND-GARRISON TRANSMISSION LINE

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

June 1982

DEFINITIONS

BPA: Bonneville Power Administration

CONTRACTOR: Constructors of the Facility

NOTE: These standards specifically address the proposed Townsend-Garrison 500 kV Transmission Line.

0.0 GENERAL

Construction of the 500 kV line shall require good construction practices reflecting the landowners' needs, environmental impacts, economics and engineering considerations. These guidelines for construction shall become part of the Contract with the successful bidder, and shall include the following: (1) general standards for CONTRACTOR performance; (2) planning and coordination; (3) construction camps or facilities; (4) public safety and protection of property; (5) access roads and vehicle movement; (6) right-of-way clearing and site preparation; (7) tower design, tower erection, and conductor stringing; (8) timing of construction; (9) fences and cattleguards; (10) grounding; (11) erosion and sediment control; (12) archaeology and history; (13) control of fires; (14) waste disposal; (15) post-construction cleanup and reclamation; and (16) post-construction activity.

The CONTRACTOR shall conduct his operations in a manner to protect the quality of the environment. These standards contain provisions which shall be considered in all the CONTRACTOR's operations.

The CONTRACTOR's specific responsibilities are described below.

1.0 GENERAL GUIDELINES FOR CONTRACTOR PERFORMANCE

1.1 The CONTRACTOR shall formally and informally brief all contractor supervisors and employees on environmental constraints prior to and during construction, and shall post such reminders on job sites.

1.2 All activities of the CONTRACTOR shall comply with the Environmental Criteria and Electric Transmission Systems issued by U.S. Departments of the Interior and Agriculture, and with all local, state, and federal environmental and sanitary requirements.

2.0 PLANNING AND COORDINATION

Prior planning of all stages of construction and maintenance activities is essential to ensure that construction-related impacts will be minimized. It also provides the only means by which the line can adequately be evaluated and further mitigation suggested. It forces the CONTRACTOR to plan in advance the use of roads, timing of construction, and other details, and allows combination of roads and special use sites where possible. Prior planning by the CONTRACTOR shall include, but is not necessarily limited to, the following:

2.1 Maintenance and access roads shall be used jointly. Roads intended to be used as permanent maintenance roads should be initially designed as such.

2.2 Maintenance routes to all points on the line should be planned before construction ends.

2.3 All excavations for sand, gravel, clay, borrow or riprap materials may be subject to either the Open Cut Mining Act or Hard Rock Mining Act, and the CONTRACTOR shall apply for necessary permits at least 60 days in advance.

3.0 CONSTRUCTION FACILITIES

3.1 The preservation of the landscape and environment shall be a primary consideration in the location of temporary construction camps, storage areas, and building required in the performance of the work.

3.2 Construction sites and staging areas shall be kept as small as possible and shall be located where most environmentally compatible, such as in areas having the flattest available slope and lacking fragile soil or vegetation types. Full restoration and reshaping of these areas including seeding and mulching shall be made following Section 15 of these Guidelines -- "Post-Construction Cleanup and Reclamation."

3.3 All work areas shall be maintained in a neat, clean, and sanitary condition at all times.

4.0 PUBLIC SAFETY AND PROTECTION OF PROPERTY

4.1 Construction operations shall not close or obstruct any portion of any railroad, public road, public trail, or other property until the necessary permits have been obtained from the authorities having jurisdiction.

4.2 Sensitive areas which have been identified, and all cultivated and planted areas and vegetation such as trees, plants, shrubs, and grass on or adjacent to the right-of-way which do not interfere with the performance of work, shall be preserved.

4.3 Reasonable precautions shall be taken to protect, in place, all public land survey monuments and private property corners or boundary markers. If any such land markers or monuments are destroyed, they shall be reestablished and referenced in accordance with the procedures outlined in the "Manual of Instructions for the Survey of the Public Land of the United States: or, in the case of private property, the specifications of the county engineer.

4.4 Firearms are not permitted to be carried in any vehicle or by personnel involved in this project while he/she is on or in the vicinity of the project right-of-way. Violators of any state, federal, or international law protecting wildlife shall be referred to the proper authorities.

4.5 Guard structures shall be installed over all existing transmission lines, distribution lines, telephone lines, and public roads that will be crossed by the conductors.

4.6 Care shall be taken to ensure that all gates are reclosed after entry or exit and that landowners incur no losses due to negligence on the part of the CONTRACTOR or his employees. Gates shall be inspected and repaired and missing padlocks shall be replaced when requested by the landowner.

4.7 Public travel through and use of active construction areas shall be discouraged.

5.0 ACCESS ROADS AND VEHICLE MOVEMENT

5.1 Construction of new roads shall be held to the absolute minimum reasonably required to construct the facility. State, county, and other existing roads shall be used for construction access wherever possible. Where new roads must be built for construction access, they shall also serve permanent maintenance access requirements, subject to the desires of the landowners.

5.2 All new roads shall be constructed with the minimum possible clearing and soil disturbance and to minimize erosion, as specified in Section 11 of these standards, entitled "Erosion and Sediment Control."

5.3 All roads shall be initially designed to accommodate the largest piece of equipment that will eventually be required to use them; road width shall be no wider than necessary.

5.4 During construction, unauthorized cross-country travel and the development of roads other than those approved shall be strictly prohibited. The CONTRACTOR shall be liable for any damage, destruction, or disruption of private property and land caused by his construction personnel and equipment as a result of unauthorized cross-country travel and road development.

5.5 The limits and location of access for construction equipment and vehicles shall be clearly marked at each new site before any equipment is moved to the site. Construction foremen and personnel shall recognize these markers and understand the restrictions on equipment movement.

5.6 Roads shall be located near the center of the right-of-way insofar as possible, enabling traffic to avoid cables and conductors during the wire-stringing operation. Necessary crossing of the right-of-way centerline should be near towers for the same reason.

5.7 Where practical, temporary roads shall be constructed on the levelest land available. Where roads cross flat land they shall not be graded or bladed unless necessary, but may be flagged to show their location.

5.8 Construction activities and travel shall be conducted to minimize dust. Water, straw, wood chips, dust pallative, gravel, combinations of these, or similar control measures may be used. Oil or similar petroleum-derivatives shall not be used.

6.0 RIGHT-OF-WAY CLEARING AND SITE PREPARATION

6.1 Clearing of survey lines shall be done using hand methods or small power tools only. During clearing of the right-of-way, shrubs shall be preserved to the greatest extent possible. Where shrub removal is necessary, brush blades and not dirt blades shall be used to minimize disturbance to roots.

6.2 Right-of-way clearing shall be kept to the minimum necessary to allow construction access and to ensure that the line will not be damaged by falling trees. In no case should the entire nominal width of the right-of-way be cleared right up to the edge; clearing should instead produce a "feathered edge" right-of-way configuration, where only specified hazard trees and those that interfere with construction or conductor clearance are removed. Smaller trees should be allowed to grow on the right-of-way and beneath the conductors. Where possible, trees and brush cut during construction should be logged and scattered, and merchantable timber should be sold.

6.3 Scalping of the earth or any unnecessary disturbances shall not be allowed on any clearing, except in rocky areas, or on slopes where cuts and fills are necessary.

6.4 No timber shall be cut or destroyed outside the right-of-way without first obtaining permission from the appropriate landowner. The CONTRACTOR shall be held liable for any unauthorized cutting, injury or destruction to timber whether such timber is on or off the right-of-way. The extent of such liability shall be to reimburse the landowner for such timber at the current market value.

6.5 Cleared materials shall be cut as close to the ground as practicable, but not exceeding 6 inches above the ground. Stumps need not be removed unless they conflict with a structure or guy anchor.

6.6 Special logging techniques, hand clearing, or hand excavation may be required in certain highly sensitive or fragile areas (such as mountain streams, scenic areas, highway crossings, and historical sites), as determined on a site-by-site basis.

6.7 Wherever appropriate, selective clearing shall be used to make curved, wavy, or irregular boundaries along the right-of-way limits. Where there is potential for long tunnel views of transmission lines or access roads, and where appropriate, special care shall be taken to screen the lines from view. This can be done by judicious use of screen planting. Where appropriate, special care shall be taken to leave a separating screen of vegetation where the right-of-way and highways and rivers are parallel (see USDI and USDA, "Environmental Criteria for Electric Transmission Systems").

6.8 All earth-moving equipment shall be operated only by qualified, experienced personnel.

6.9 The CONTRACTOR's general foreman shall make sure that crane pads are constructed in accordance with accepted construction practices, and that only one crane pad is constructed per tower site. Construction of crane pads shall not be allowed on level ground except for extreme conditions (such as soft or marshy ground).

6.10 No motorized travel on, scarification of, or displacement of stabilized talus slopes shall be allowed except where absolutely necessary.

6.11 The CONTRACTOR shall take reasonable measures to avoid the creation of noise levels that are safety or health hazards.

6.12 The CONTRACTOR shall take all necessary actions to avoid adverse impacts of sensitive areas which may include, but are not limited to, scenic, historical and archaeological areas, fish and wildlife refuges, water supply watersheds, and public recreational areas such as parks and monuments.

7.0 TOWER DESIGN, TOWER ERECTION, AND CONDUCTOR STRINGING

7.1 Helicopters shall be used to string socklines, transport tower structures, and to erect towers where warranted on an economic or environmental basis.

7.2 At certain wetlands heavily used by migratory birds, certain measures may be required to reduce the incidence of wire strikes. These changes may include but are not necessarily limited to use of self-supporting rather than guyed towers, local habitat modification, or installation of devices such as flags or marker balls on static wires.

8.0 TIMING OF CONSTRUCTION

Construction and motorized travel may be restricted or prohibited at certain times of the year at critical sites which differ seasonally in sensitivity to construction-related disturbances. They includes sites:

a. in the vicinity of heavily used recreation sites on weekends or holidays;

b. on or near winter ranges or other areas important to moose, elk, deer, antelope, mountain sheep, and mountain goats during the appropriate months;

c. in the vicinity of rookeries, active grouse strutting and dancing grounds, or raptor nests during spring and summer;

d. in or near streams during seasons of migratory fish spawning.

9.0 FENCES AND CATTLEGUARDS

9.1 All fences crossed by this powerline shall be provided with a gate not less than 16 feet wide. All fences crossed by the right-of-way or access roads shall be "H" braced, before the fence is cut.

9.2 Cattleguards, when required, shall be aligned at right angles with the roadway and shall be accompanied by an off-road gate wide enough for all construction equipment.

9.3 The CONTRACTOR shall immediately replace all fencing and gates that are cut, removed, damaged, or destroyed by him with new materials to the original standard, except that undamaged gates may be reused.

10.0 GROUNDING

10.1 Barbed wire and woven wire fences on the right-of-way shall be grounded. At a minimum, fences which cross the right-of-way shall be grounded on each side of the gate opening and at each edge of the right-of-way. Fences which run on the right-of-way parallel to the centerline shall be grounded at a maximum of 200 foot intervals.

10.2 All metallic objects other than fences which are on the right-of-way, such as buildings with metallic roofs, sides and metallic piping systems installed above ground, shall be adequately grounded.

10.3 Generally, metallic objects off the right-of-way shall not require grounding; however, each metallic installation insulated from ground shall be reviewed on an individual basis to see if grounding is needed.

11.0 EROSION AND SEDIMENT CONTROL

11.1 Clearing and grubbing for roads and rights-of-way and excavations for stream crossing shall be carefully controlled to minimize silt or other water pollution downstream from the rights-of-way. Sediment retention basins may be required if silting occurs.

11.2 Roads shall cross drainage bottoms at sharp or nearly right angles and level with the streambed gradient whenever possible.

11.3 Under no circumstances shall streambed materials be removed for use as backfill, embankments, or for other construction purposes. No excavations shall be allowed on any river or live stream channels or floodways at locations likely to cause detrimental erosion or offer a new channel to the river or stream at times of flooding.

11.4 No blasting shall be allowed in streams. Blasting may be allowed near streams if precautions are taken to adequately protect the stream from debris.

11.5 The CONTRACTOR shall maintain roads while using them. All ruts made by machinery shall be filled to prevent channeling. In addition, the CONTRACTOR must take measures to prevent the occurrence of erosion caused by wind or water during and after use of these roads. Some erosion-preventive measures include but are not limited to installing or using cross logs, drain ditches, water bars, and wind erosion inhibitors such as water, straw, gravel, or combinations of these items.

11.6 The CONTRACTOR is required to prevent material from being deposited in any watercourse or stream channel. Where necessary, measures such as hauling of fill material, construction of temporary barriers, or other approved methods shall be used to keep slash, excavated materials, and other extraneous materials out of watercourses. Any escaped fill, slash, etc., shall be removed immediately from watercourses.

11.7 Where required, coarse rock encountered in the excavation shall be used as far as practicable for constructing the sides of new embankments adjacent to or parallel with any affected stream where such material may serve as protection against slope or channel erosion. The CONTRACTOR shall be responsible for the stability of all embankments made under the contract until final acceptance of the work. Embankments and backfills shall contain no muck, frozen material, large roots, sod, or other deleterious matter. The CONTRACTOR shall prevent the escape of fill material by the construction of toe ditches or by the erection of rock, boulder, earth, or log barriers at the toes of embankments, or by other suitable methods.

11.8 Culverts or arch bridges shall be installed at all crossings of flowing or dry watercourses where fill is likely to wash out during the life of the road. Culvert or bridge installation is prohibited in areas of important fish spawning beds and during specified fish spawning seasons on less sensitive streams or rivers. Culverts shall be of sufficient size to handle approximately 25-year floods. Culvert size shall be determined following procedures given in the Hydraulics Manual of the Montana Department of Highways (Peil and Weaver, 1975), or by equivalent standard procedures which take into account the variations in vegetation and climatic zones in Montana, the amount of fill, and the drainage area above the crossing.

11.9 No fill material other than that necessary for road construction shall be piled within the high water zone of streams where floods can transport it directly into the stream. Excess floatable debris shall be removed from areas immediately above crossings to prevent obstruction of culverts or bridges during periods of high water.

11.10 No skidding of logs or driving of vehicles across a perennial watercourse shall be allowed, except via authorized construction roads. No perennial watercourses shall be blocked or diverted.

11.11 Construction activities shall use methods that will prevent accidental spillage of solid matter, contaminants, debris, petroleum products, and other objectionable pollutants and wastes into watercourses, lakes, and underground water sources. Catchment basins shall be installed at storage areas to contain accidental spills of fuel, chemicals, oil, etc.

11.12 When operations in a work area are complete, all temporary structures or fills installed to aid stream crossing shall be removed and the thread of the stream reestablished to prevent future erosion.

11,13 All temporary dams built on the right-of-way shall be removed within five years of their construction or be upgraded to permanent structures with either spillways or culverts, and a continuous sod cover on their tops and downstream slopes. Spillways may be protected against erosion with riprap or equivalent means.

12.0 ARCHAEOLOGY AND HISTORY

12.1 BPA shall engage a competent archaeologist familiar with the area to designate areas likely to be of archaeological and historical significance, and to design an appropriate field survey. Such field work and appropriate mitigative measures shall be completed for any finds prior to the start of construction.

12.2 If any artifacts or items of apparent archaeological or historic significance are discovered before or during construction, care shall be taken not to disturb the artifacts or surrounding area, and the archaeologist shall be notified immediately.

12.3 Any relics, artifacts, fossils or other items of historical or archaeological value shall be preserved in a manner agreeable to both the landowner and the State Historic Preservation Officer.

13.0 CONTROL OF FIRES

13.1 A fire plan shall be proposed that sets forth in detail the plan for prevention, control and extinguishing of fires on and near the project area.

13.2 The CONTRACTOR shall comply with any county, town, state or governing municipality having jurisdiction regarding fire laws and regulations.

13.3 Blasting caps and powder shall be stored only in approved areas and containers and always separate from each other.

13.4 The CONTRACTOR shall provide necessary equipment for fire prevention and suppression. Spark arresters and additional mufflers on some engines may be required in areas of high fire danger.

13.5 The CONTRACTOR shall properly store and handle combustible material which could create objectionable smoke, odors, or fumes. The CONTRACTOR shall not burn refuse such as trash, rags, tires, plastics, or other debris, except as may be permitted by the county, town, state, or governing municipality having jurisdiction.

14.0 WASTE DISPOSAL

14.1 General cleanup of the right-of-way and access roads shall be done by the CONTRACTOR for the duration of the project.

14.2 Disposal of any materials, waste, effluents, trash, garbage, oil, grease, chemicals, etc., shall be subject to the approval of the landowner.

14.3 All used oil or other petroleum products shall be hauled away. There shall be no release of crankcase oil or other toxic substances into streams or the soil.

14.4 Sanitary waste shall not be discharged into streams or any streambeds. The CONTRACTOR shall provide refuse containers and sanitary chemical toilets, convenient to all principal points of operation. These facilities shall comply with applicable federal, state, and local health laws and regulations.

14.5 Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete lift cleanup, and other waste water processes shall not be discharged into surface waters.

14.6 All non-combustible wastes such as conductor, ceramic or metal scrap shall be hauled away or buried. Permission shall be obtained from the landowner before burial of these wastes.

14.7 Complete disposal of all slash made by the project shall be required. Some slash may be used in constructing barriers to inhibit travel on closed roads along the right-of-way.

14.8 Combustible wastes such as packaging material shall be hauled away and disposed of upon leaving any work area.

14.9 Generally, combustible wastes shall not be burned. Instances where disposal by burning seems preferable, it shall require the prior approval of the landowner, and shall be done with small fires only to dispose of construction waste.

15.0 POST-CONSTRUCTION CLEANUP AND RECLAMATION

15.1 Subject to the desire of the landowner and the integrity of the tower foundation and anchors, all signs of temporary construction facilities such as haul roads, work areas, buildings, foundations or temporary structures, stockpiles or excess or waste materials, or any other vestiges of construction shall be removed and the areas restored to as natural a condition as is practical.

15.2 Grading and scarifying of roadways shall be required where appropriate and required by the landowner to restore the area to near natural conditions that will permit the growth of vegetation and discourage future traffic.

15.3 Any landscape feature scarred or damaged by equipment or operations shall be restored as nearly as practical to its original condition. Bare areas created by construction activities will be reseeded to prevent soil erosion.

15.4 In areas where no cut or fill was made, closure of roads, subject to landowner approval, shall be done by installing signs, constructing rock barriers, soil berms, planting trees, or other approved means after completion of scarifying, water-barring and revegetation in these areas.

15.5 Replacement of earth adjacent to access roads crossing streams shall be at slopes less than the normal angle of repose for the soil type involved.

15.6 Disturbance of drainage bottoms shall be minimal, and all drainage bottoms shall be restored to their preconstruction gradient and width to prevent accelerated gully erosion.

15.7 Cross drains and water bars shall be added at an angle and as frequently as appropriate to satisfy road grades.

15.8 Interrupted drainage systems shall be restored for all cleared centerlines.

15.9 Species used in reseeding shall be as specified in the accompanying table.

15.10 All litter is to be removed from the right-of-way and along access roads leading to the right-of-way within 30 days of completion of wire stringing and splicing. If requested by the landowner, BPA shall provide for removal of any additional debris after this initial cleanup.

Seeding Prescriptions

	Species	lbs/acre	Seeding Method
Dry site Low elevation	Western wheatgrass (Agr smi)	4.5	Drill[4]
	Bluebunch wheatgrass (Agr spi)	4.5	
	Thickspike wheatgrass (Agr das)	5.0	
	Prairie sandreed (Cal lon)	2.0	
	Little bluestem (Sch sco)[1]	-	
	Sideoats grama (bou cur)	3.0	
	Blue Grama (Bou gra)[2]	-	
	Eski sainfoil (Ono vic)	1.0	
Dry site High elevation	Bluebunch wheatgrass (Agr spi)	5.0	
	Green needlegrass (Sti vir)	3.0	
	Mountain brome (Bro mar)	8.0	
	Blue grama (Bou gra)	1.0	
	Little bluestem (Sch sco)	2.0	
	Eski Sainfoil (Ono vic)	1.0	
Wet site Low elevation	Switchgrass (Pan vir)	6.5	
	Reed canarygrass (Pha aru)	11.5	
	Sand dropseed (Spo cry)	1.0	
	Alkali sacaton (Spo air)[3]	-	
	Eski sainfoil (Ono vic)	1.0	
Wet site High elevation and Alpine	Garrison creeping meadow foxtail (Alo aru)	2.0	
	Mountain brome (Bro mar)	10.0	
	Spike trisetum (Tri spi)	3.0	
	Tufted hairgrass (Des cae)	2.0	
	Orchard grass (Dac glo)	2.0	
	Alpine timothy (Phl alp)	1.0	

[1] If prairie sandreed is unavailable use little bluestem at an equivalent seeding rate to prairie sandreed.

[2] If sideoats grama is unavailable use blue grama at 1/3 the seeding rate of sideoats grama.

[3] If sand dropseed is unavailable use alkali sacaton at 1/3 the seeding rate of sand dropseed.

[4] If seed is hand-broadcast use twice (2x) the drill rate.

15.11 Any existing waste material moved or disturbed shall be placed on the right-of-way so that it does not form fire hazards or stock barriers, and not block access to the right-of-way or to structure sites. Waste material includes disposable material such as tops, limbs, brush, uprooted stumps, unmerchantable logs, buildings designated for disposal, building debris, and other disposable debris. The degree of disposal to be performed is dependent on the existing land use. Occasional tops, limbs, and brush to 3 inches in diameter and to 3 feet in length may be left on other than cropland and residential land.

15.12 Piling and windrowing of material for burning shall be by tractor equipped with a forked clearing blade except where equipment is prohibited. In areas where such equipment is prohibited, methods that will prevent soil from being included in the material to be burned shall be used to minimize destruction of ground cover, and to minimize erosion. Piles shall be relatively small and compact so as to minimize danger to timber and damage to ground cover.

15.13 BPA is responsible for correcting cultivated land compacted by equipment.

15.14 If difficulties in revegetation are anticipated, stockpiling of topsoil to be spread on road cuts prior to reseeding is encouraged.

15.15 Sufficient seeds and fertilizer, of specific percentage purity, germination, and inert material, shall be ordered early enough to ensure reseeding during the first agricultural planting season after construction ends for each segment of line.

15.16 Where appropriate, hydroseeding or drilling and seeding shall be used to aid revegetation. Mulching with straw or wood chips shall be used where necessary.

15.17 Revegetation shall not be considered complete until the following criteria are met:

a. In rangeland, coverage or perennial species shall be 30% or more of that on adjacent rangeland the year following revegetation, and 90% or more of the coverage of adjacent rangeland with the five years following revegetation.

b. In forest land, revegetated land exclusive of the right-of-way or permanent roads shall be stocked with trees by the end of five years so that the approximate stocking level of adjacent forest, or canopy closure, whichever is less, will be attained at maturity.

16.0 POST-CONSTRUCTION ACTIVITY

As a follow-up after construction, the following shall be done, subject to the desires of the landowner:

16.1 Vegetation, particularly that of value to fish and wildlife, which has been saved through the construction process and which does not pose a hazard to the powerline, shall be nurtured and allowed to grow on the right-of-way.

16.2 Vegetation cover shall be maintained, if appropriate, in the areas immediately adjacent to transmission towers.

16.3 Native trees, shrubs, herbs and grass shall be kept; where ecologically appropriate in critical areas, vegetation of this type shall be placed under the direction of the appropriate land management agent or a qualified ecologist.

16.4 If and where permitted, access roads and service roads shall be maintained with grass cover, water bars, cross drains, and the proper slope in order to prevent soil erosion.

16.5 Maintenance inspections shall be timed so that routine maintenance will be done when access roads are firm, dry or frozen. Maintenance vegetative clearing in particularly critical areas shall be done on a short cycle to satisfy minimal requirements and to avoid heavy, long-term cutbacks.

16.6 Aircraft shall normally be used to inspect the powerline facility. Aerial inspection and ground maintenance activities of the powerline facility shall include observations of soil erosion problems, fallen timber, and conditions of the vegetation that require attention.

MONTANA
DEPARTMENT OF NATURAL RESOURCES
& CONSERVATION

Helena, Montana

graphics by the
cartography bureau

150 copies of this public document were published at an estimated cost of $4.49 per copy, for a total cost of $674.57, which includes $674.57 for printing and $.00 for distribution.